PRACTICAL
ELECTRONICS
MAY 1975
30p

Starts this month!

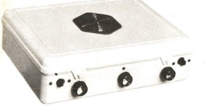
Australia	65c
New Zealand	65c
South Africa	60c
Rhodesia	60c
Malaysia	$2.10
Norway	Kr.6.00
Malta	27c.5
Sweden	Kr.4.90

A CHOICE OF VOICES

with this TOUCH SENSITIVE INSTRUMENT

Conventional Piano - Harpsichord - Honky Tonk

PE JOANNA



NEW EDU·KIT MAJOR

COMPLETELY SOLDERLESS ELECTRONIC CONSTRUCTION KIT
BUILD THESE PROJECTS WITHOUT SOLDERING IRON OR SOLDER

- 4 Transistor Earpiece Radio
- Signal Tracer
- Signal Injector
- Transistor Tester NPN —PNP
- 4 Transistor Push Pull Amplifier
- 5 Transistor Push Pull Amplifier
- 7 Transistor Loudspeaker Radio MW/LW.
- 5 Transistor Short Wave Radio
- Electronic Metronome
- Electronic Noise Generator
- Batteryless Crystal Radio.
- One Transistor Radio
- 2 Transistor Regenerative Radio
- 3 Transistor Regenerative Radio
- Audible Continuity Tester
- Sensitive Pre-Amplifier

Components include:

● 24 Resistors ● 21 Capacitors ● 10 Transistors ● 3½″ Loudspeaker ● Earpiece ● Mica Baseboard ● 3 12-way Connectors ● 2 Volume Controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 yard of sleeving, etc. ● Parts price list and plans 55p (free with parts)

TOTAL BUILDING COSTS

£7·23 (+8% VAT 57p) **P.P. & Ins. 44p (Overseas Seamail P. & P. £2·35)**

NEW ROAMER NINE

WITH V.H.F. INCLUDING AIRCRAFT

Nine Transistors, 9 Tunable wavebands as Roamer Ten. Built in ferrite rod aerial for MW/LW. Retractable chrome plated telescopic aerial for VHF and SW. Push Pull output using 600 mW transistors. 9 Transistors and 3 diodes, tuning condenser with VHF section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange controls. Attractive all white case with red grille and carrying strap. Size 9¼in × 7in × 2¾in approx. Parts price list and plans free with parts.

TOTAL BUILDING COSTS £6·95 (+8% VAT 55p) **P.P. & Ins. 44p (Overseas Seamail P. & P. £2·35)**

POCKET FIVE

NOW WITH 3″ LOUDSPEAKER

3 Tunable wavebands. MW/LW and Trawler Band. 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive Black and Gold Case. Size 5½in × 1½in × 3½in approx. Plans and parts price list free with parts.

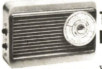
Total Building Costs

£2·50

(+8% VAT 20p)

P.P. & Ins. 36p

(Overseas Seamail P. & P. £1·70)



TRANSONA FIVE NOW WITH 3″ LOUDSPEAKER

Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and parts price list free with parts.

Total Building Costs

£2·75 P.P. & Ins. 36p (+8% VAT 21p) **(Overseas Seamail P.&P. £1·70)**

NEW EVERYDAY SERIES

Build this exciting New series of designs

EV5 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, **and now with 3″ loudspeaker.** Attractive case with red speaker grille. Size 9in × 5¼in × 2¾in approx. Parts price list and plans free with parts.

TOTAL BUILDING COSTS £2·95 (+8% VAT 23p) **P.P. & Ins. 36p (Overseas Seamail P. & P. £1·70)**

EV6 Case and looks as above.
6 Transistors and 3 diodes. Powered by 9 volt Battery. Ferrite rod aerial, 3″ loudspeaker, etc., MW/LW coverage. Push Pull Output. Parts price list and plans free with parts.

TOTAL BUILDING COSTS £3·60 (+8% VAT 29p) **P.P. & Ins. 36p (Overseas Seamail P. & P. £1·70)**

EV7 Case and looks as above.
7 transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1, SW2, SW3, powered by 9 volt Battery Push Pull Output. Telescopic Aerial for Short Waves. 3″ Loudspeaker. Parts price list and easy build plans free with parts.

TOTAL BUILDING COSTS £4·08 (+8% VAT 32p) **P.P. & Ins. 38p (Overseas Seamail P. & P. £2·00)**

ROAMER EIGHT Mk. I

NOW WITH VARIABLE TONE CONTROL

7 TUNABLE WAVEBANDS: MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND. Built-in ferrite rod aerial for MW and LW. Chrome plated telescopic aerial can be angled and rotated for peak short-wave listening. Push-pull output using 600mW transistors. Car aerial and tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Latest 4″ 2 watt Ferrite Magnet loudspeaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9in × 7in × 4in approx. Easy to follow instructions and diagrams. Parts price list and plans free with parts.

TOTAL BUILDING COSTS £6·98 (+8% VAT 56p) **P.P. & Ins. 47p (Overseas Seamail P. & P. £2·50)**

ROAMER TEN Mk. II

WITH VHF INCLUDING AIRCRAFT

10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND, VHF AND LOCAL STATIONS. ALSO AIRCRAFT BAND

Now with free earpiece and switched socket.

Latest 4″ 2 watt Ferrite Magnet Loudspeaker. Built-in ferrite rod aerial for MW/LW. Chrome plated 6 section telescopic aerial, can be angled and rotated for peak short wave and VHF listening. Push-pull output using 600mW transistors. Car Aerial and tape record sockets. 10 transistors plus 3 diodes. Ganged tuning condenser with VHF section. Separate coil for Aircraft Band. Volume/on/off, wave change and tone controls. Attractive case in black with silver blocking. Size 9in × 7in × 4in. Easy to follow instructions and diagrams. Parts price list and plans **50p** (FREE with parts).

TOTAL BUILDING COSTS £9·50 (+8% VAT 76p) **P.P. & Ins. 52p (Overseas Seamail P. & P. £2·50)**

EDU-KIT

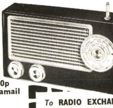
Build Radios Amplifiers, etc., from easy stage, diagrams.

Five units including master unit to construct.

Components include: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine tone 3″ moving coil Speaker: Terminal Strip: Ferrite Rod Aerial: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ½in Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction. Parts price list and plans free with parts.

TOTAL BUILDING COSTS £5·50 (+8% VAT 44p) **P.P. & Ins. 40p (Overseas Seamail P. & P. £2·35)**

TRANS EIGHT 8 TRANSISTORS AND 3 DIODES



6 TUNABLE WAVEBANDS, MW, LW, SW1, SW2, SW3 AND TRAWLER BAND. Sensitive ferrite rod aerial for MW. and LW. Telescopic aerial for short waves. 3in speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9in × 5¼in × 2⅝in approx. Push-pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans free with parts.

TOTAL BUILDING COSTS £4·48 P.P. & Ins. 40p (Overseas Seamail P. & P. £2) (+8% VAT 36p)

ROAMER SIX

CASE AND LOOKS AS TRANS EIGHT 6 TUNABLE WAVEBANDS: MW, LW, SW1, SW2, TRAWLER BAND PLUS AN EXTRA MW BAND FOR EASIER TUNING OF LUXEMBOURG, ETC. Sensitive ferrite rod aerial and telescopic aerial for short waves. 3in speaker. 8 stages—6 transistors and 2 diodes, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9in × 5¼in × 2⅝in approx. Plans and parts price list free with parts.

TOTAL BUILDING COSTS £3·98 P.P. & In. 40p (Overseas Seamail P. & P. £2·00) (+8% VAT 32p)

RADIO EXCHANGE LTD

*Callers side entrance "Lavells" shop
*Open 10-1. 2.30-4.30. Mon.-Fri. 9-12 Sat.

To **RADIO EXCHANGE CO., 61a HIGH STREET, BEDFORD MK40 ISA**
Tel. 0234 52367 Reg. No. 788372

I enclose £ .... for ....

Name ....

Address ....

PE5

PRACTICAL
ELECTRONICS

VOLUME 11 No. 5 MAY 1975

CONSTRUCTIONAL PROJECTS

P.E. JOANNA—1 *by A. J. Boothman*
A multiple-voiced instrument with touch-sensitive keying 384

TOUCH TUNING UNIT *by R. J. Bonfield*
Auto-touch-tuning for the P.E. Varicap Tuner 392

CAR INDICATOR/EMERGENCY FLASHER *by J. B. Dance*
Single-chip auxiliary car flasher for negative earth vehicles 410

I.C. PULSE GENERATOR *by A. C. Ainslie*
Versatile design for a t.t.l.-compatible variable frequency pulse source 414

GENERAL FEATURES

NEW DEVICES . . . APPLICATIONS
Ultrasonics in TV remote control applications 398

LOUDSPEAKER BREAKTHROUGH
An old idea made possible using modern techniques 400

TRANSDUCERS—2 *by P. R. Allcock*
Thermometers and Strain Gauges 404

HIGH INPUT IMPEDANCE TECHNIQUES *by R. A. Penfold*
Obtaining high input impedances with modern semiconductors 420

INGENUITY UNLIMITED
Telephone Bell Synthesiser—Two-wire Signalling System—Counter System—Seven-segment To BCD Decoder—Sound Switch/Trigger—TTL Oscillator 425

NEWS AND COMMENT

EDITORIAL—Discordant Voices 383

SPACEWATCH *by Frank W. Hyde*
1975 Space Programme 391

NEWS BRIEFS
Radio System—Hot Wind—Symbol for Safety—Scramblers Abroad—Tubeless Cameras 397, 421

BOOK REVIEWS
Selected new books we have received 403

MILD & BITTER *by A.P.S.*
The Calculator Bore 413

INDUSTRY NOTEBOOK *by Nexus*
What's happening inside industry 422

PATENTS REVIEW
The EEC industrial property law and its effect on British Patents 430

READOUT
A selection of readers' letters 431

Our June issue will be published on Friday, May 9, 1975

© IPC Magazines Limited 1975. Copyright in all drawings, photographs and articles published in PRACTICAL ELECTRONICS is fully protected, and reproduction or imitations in whole or part are expressly forbidden. All reasonable precautions are taken by PRACTICAL ELECTRONICS to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it, and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press. Publisher's Subscription Rate including postage for one year, Inland £3·85, Overseas £4·70. USA and Canada $13·00. International Giro facilities Account No. 5122007. State reason for payment, "message to payee".

CHINAGLIA

PROFESSIONAL QUALITY
TEST EQUIPMENT

THE
MINOR
WITH
33 RANGES
20kΩ/V d.c.
4kΩ/V a.c.

- ROBUST CLASS 1·5 PRECISION MOVEMENT
- ACCURACY 2·5% D.C. AND 3·5% A.C.
- 12 MONTH GUARANTEE
- SELF-POWERED AND POCKET-SIZED
- OPTIONAL 30kV D.C. PROBE

PRICE £16·30 inc. VAT (P. & P. 80p)
PROBE £8·80

For details of this and the many other exciting instruments in the Chinaglia range, including multimeters, component measuring, automotive and electronic instruments please write or telephone:

CHINAGLIA
(U.K.) LTD. 19 Mulberry Walk, London
SW3 6DZ Tel: 01-352 1897

TRADE ENQUIRIES WELCOMED

become a RADIO-AMATEUR!

learn how to become a radio-amateur in contact with the whole world. We give skilled preparation for the G.P.O. licence

RAPY

free! Brochure, without obligation to:
BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL
Dept. EB55, P.O. Box 156, JERSEY

NAME :
ADDRESS :
BLOCK CAPS please

CJL PRICES INCLUDE P&P AND V.A.T.

BIB HI-FI ACCESSORIES		
☐CASSETTE TAPE RECORDER CARE KIT		£1.95
☐CASSETTE SPLICING AND EDITING KIT		£1.50
☐HI-FI STEREO TEST CASSETTE		£2.10
☐¼" TAPE EDITING KIT		£1.35
☐GROOV-KLEEN RECORD CLEANER		£1.85
COMPONENT PACKS		
☐CAPACITORS-Electrolytic-Tubular Submin-Mixed		£0.50
☐CAPACITORS-P.C.B. Polyester-Mixed Preferred		£0.50
☐RESISTORS-Carbon Film-Mixed Preferred		£0.50
☐POTENTIOMETERS-Midget Carbon Track-Mixed		£0.50
☐**EARPHONE**, stethoscope style, 8 ohm dynamic		£1.00
☐**HAND DRILL**, (Leytool), compact precision drill, 5/16" chuck. Gears totally enclosed. S/L bearings		£2.99
INTEGRATED CIRCUITS		
☐AUDIO POWER AMPLIFIER (National)	LM380	£1.00
☐A.M. RADIO RECEIVER (RCA)	CA3123E	£1.40
☐F.M. STEREO DECODER (Motorola)	MC1310P	£2.80
☐TIMER (Signetics)	NE555V	£0.78
☐VOLTAGE REGULATOR (Fairchild)	uA7805	£1.70
☐VOLTAGE REGULATOR (Signetics)	NE550A	£0.80
☐D.I.L. SOCKETS (Pk of 3)	8 or 14 pin	£0.50
☐**KEYNECTOR**, rapid connect to mains-single/multiple leads. Built-in piano switches, neon & 13A fuse		£3.20
☐**LOCKFLEX RULE**, (Rabone Chesterman), 3m/10ft precision pocket rule. Easy to read, 13mm/½" wide steel tape. Blade length lockable-power return. A superb rule		£0.93
☐**MICROPHONE**, lightweight dynamic, remote start stop, 200 ohms, 100-10kHz, 6mV average output		£1.80
☐**SIGNAL INJECTOR**, audio through video signals, excellent for servicing amplifiers, radio & tv		£3.92
☐**SOLDERING IRON, 25 WATT**, (Antex), X25, 240V, Very low leakage, 1/8" long life bit (interchangeable)		£1.85
☐3/32" bit £0.45 ☐3/16" bit £0.45 ☐Element		£0.95
☐**STAND**, ST3, High grade base, chrome plated spring, sponges and accomodation for spare bits.		£0.95

CJL CJL LTD. P.O. BOX 34, CANTERBURY, CT1 1YT

SAXON

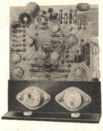
Money saving high performance audio equipment
DIRECT FROM OUR OWN FACTORIES

GUARANTEED TESTED HIGH PERFORMANCE MODULES—now better value than ever

SA35 35W RMS 25–50V 7 transistors, 7 diodes	**£6·60**	Carriage free
SA50 50W RMS 25–65V 7 transistors, 7 diodes	**£8·50**	Carriage free
SA100 100W RMS 45–70V 10 transistors, 7 diodes	**£12·50**	Carriage free

- ★ 25Hz–25kHz
- ★ 0·2% distortion
- ★ Noise—80dB
- ★ 500mV into 20K
- ★ 4–16 ohms
- ★ Simple wiring
- ★ Short and open circuit proof
- ★ Continuously rated
- ★ Top-grade components

120 watt module complete with built-in supply—extra heavy duty £24·75 Carr. 60p



THE SA100 MODULE

POWER SUPPLIES

UNSTABILISED—READY WIRED AND FUSED

PU45	Suits 2 SA35 or 1 SA50 (4 ohm)	**£6·50**	Carriage 50p
PU70	Suits 2 SA50 or 2 SA100 (8 ohm)	**£9·50**	Carriage 60p

STABILISED

PS45	Suits 2 SA35 or 2 SA50 (4 ohm)	**£5·50**	Carriage free
MT45	Transformer for above	**£3·90**	Carriage 50p
PS70	Suits 2 SA100	**£6·50**	Carriage free
MT70	Transformer for above	**£5·50**	Carriage 60p

N.B. PS70 is not suitable for the SA50

Mk II STEREO DISCO MIXER £29·50

Carr. 50p

This well tried Pre-Amp mixes two decks, handles any ceramic cartridge, and features mic over-ride plus separate full range bass and treble controls on both mic and deck inputs. Ample headphone power is available for P.F.L. May be used for mono and is mains operated. Fitted with sturdy screening case. Controls: Mic vol, bass, treble. Left/Right fade, deck volume, bass, treble, h/phone select, vol, Mains. Size 17½in × 3in × 4in deep.

DISCO MODULE £12·50 Carr. 50p

Thousands sold of this extremely popular mono Pre-Amp. A mic input may be fitted using the VA30 (see below). Low consumption from a 9V battery. Features the same high standards of reproduction as the Stereo version. Controls: H/phone select, vol, Left deck vol, Right deck vol, bass, treble, master vol. Size 12¾in × 3in × 2in deep.

3-CHANNEL SOUND-LITE £24·75 Carr. 50p

Only SAXON can supply such incredible value for money. This unit features 3kW power handling, full-wave control, bass, middle, treble AND master controls. Twin loudspeaker jacks for "through" connections. It may be used free standing or will panel mount next to either of the above. Also features unique CUT-BACK circuitry for extra wide range response. Size 12in × 3in × 2½in deep. Professional standards at a price you can afford!

SINGLE CHANNEL VERSION £7·90
Carr. free

High sensitivity, compact, handles 1kW. Full wave operation

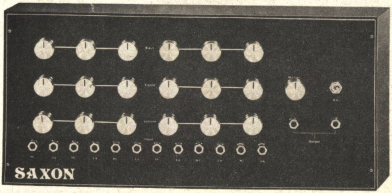
Add 8% VAT to all orders

MULTI-PURPOSE MIXERS

M4HL
£25·00 Carr. 60p

M6HL
£35·00 Carr. 60p

Featuring multiples of our VA30 module, the M4HL and M6HL fulfil the requirements of all clubs, groups, etc. where a high quality mixer is required. Each channel has one high and one low impedance input, plus volume, treble and bass controls. Input impedances may, if required, be easily changed, The M4HL has four channels, and one output, and the M6HL six channels (12 inputs) and a master control and two outputs. Either unit may be used free-standing or panel mounted. These mixers will feed all types of amplifier. Recommended for their versatility and high performance, and excellent value for money.



VA30 CHANNEL MODULE £3·90 Carr. free

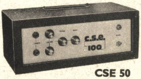
This is the basic channel module in the above mixers and may also be used for extra inputs on either the mono or stereo mixers. Fitted with volume, bass and treble controls, requires just a jack and supply (9–100V)

SAXON CSE 100

COMPLETE AMPLIFIER

£39·90
Carr. 60p

100W of speech and music—Two separately controlled inputs. Wide range bass and treble controls. Sturdy and attractive vynide case. Twin outputs. Ideal for groups, discos, etc. Fully tested and guaranteed. 50W version identical in appearance.



CSE 50
£33·00 Carr. 60p

NEW!!

SAXON MULTIMIX 100 £57 CARR. £1·00

100W RMS **SLIDER** controls **PLUS** master slider. Wide range bass and treble controls—fantastic value. Ideal for complete Disco's, Groups, Clubs, etc.

SAXON MULTIMIX 50 EXACTLY AS ABOVE BUT 50W RMS **£45**

CALLERS AND MAIL ORDER:
SAXON ENTERTAINMENTS LIMITED
327-333 WHITEHORSE ROAD • CROYDON CR0 2HS
(Please quote magazine when ordering)
SHOP HOURS: 9 a.m. 5 p.m. — LUNCH 12.30 1.30 p.m. MAIL ORDER DESK: 10 a.m.-3 p.m.
24-HOUR ANSWER SERVICE TEL. 01-684 6385. TECHNICAL ENQUIRIES 01-684 0098

SEND 15p FOR OUR NEW 26-PAGE MANUAL—full circuits and details.

TERMS OF BUSINESS: C.W.O., C.O.D. or ACCESS (just send in card number). Send 50p. for C.O.D.

Please include S.A.E. with all enquiries.

VAT at 8% must be added to all orders including carriage charges.

TRANSFORMERS

SAFETY MAINS ISOLATING TRANSFORMERS
Prim. 120/240V. Sec 120/240V Centre Tapped and Screened

ALSO AVAILABLE WITH 115/120V SEC. WINDING

Ref.	VA	Weight		Size cm.	P & P	
No.	(Watts)	lb	oz		£	p
07	20	1	8	7·0 × 6·0 × 6·0	2·80	38
149	60	3	12	9·9 × 7·7 × 8·6	4·37	45
150	100	5	8	9·9 × 8·9 × 8·6	4·89	45
151	200	8	0	12·1 × 9·3 × 10·2	8·13	53
152	250	13	12	12·1 × 11·8 × 10·2	9·83	73
153	350	15	0	14·0 × 10·8 × 11·8	11·88	73
154	500	19	8	14·0 × 13·4 × 11·8	13·65	91
155	750	29	0	17·2 × 14·0 × 14·0	20·51	*
156	1000	38	0	17·2 × 16·6 × 14·0	29·15	*
157	1500	46	0	21·6 × 13·4 × 18·1	33·23	*
158	2000	60	0	21·6 × 15·3 × 18·1	37·07	*

AUTO TRANSFORMERS

Ref.	VA	Weight		Size cm.	Auto Taps	P & P	
No.	(Watts)	lb	oz			£	p
113	20	1	0	5·8 × 5·1 × 4·5	0-115-210-240	1·67	30
64	75	2	4	7·0 × 6·7 × 6·1	0-115-210-240	2·90	38
4	150	3	4	8·9 × 7·7 × 7·7	0-115-200-220-240	4·12	45
66	300	6	4	9·9 × 9·6 × 8·6	,, ,,	5·82	53
67	500	12	8	12·1 × 11·2 × 10·2	,, ,,	8·82	67
84	1000	19	8	14·0 × 13·4 × 14·3	,, ,,	13·68	91
93	1500	30	4	14·0 × 15·9 × 14·3	,, ,,	18·31	*
95	2000	32	0	17·2 × 16·6 × 14·0	,, ,,	24·20	*
73	3000	40	0	21·6 × 13·4 × 18·1	,, ,,	35·09	*

CASED AUTO TRANSFORMERS

115V mains lead input and U.S.A. 2-pin outlets, 20VA **£3·13.** P & P 38p. 500VA **£10·45,** P & P 80p. 1000VA **£17·51,** via B.R.S.

LOW VOLTAGE SERIES (ISOLATED)
PRIMARY 200-250 VOLTS 12 AND/OR 24 VOLT RANGE

Ref.	Amps.		Weight		Size cm.	Secondary Windings	P & P	
No.	12V	24V	lb	oz			£	p
111	0·5	0·25		8	4·8 × 2·9 × 3·5	0-12V at 0·25A × 2	1·47	23
213	1·0	0·5	1	4	6·1 × 5·8 × 4·8	0-12V at 0·5A × 2	1·74	30
71	2	1	1	12	7·0 × 6·4 × 6·1	0-12V at 1A × 2	2·29	38
18	4	2	2	12	8·3 × 7·7 × 7·0	0-12V at 2A × 2	2·86	38
70	6	3	3	8	8·9 × 8·0 × 7·7	0-12V at 3A × 2	4·12	45
108	8	4	5	8	9·9 × 8·9 × 8·6	0-12V at 4A × 2	4·56	45
72	10	5	6	4	9·9 × 9·6 × 8·6	0-12V at 5A × 2	5·14	53
116	12	6	6	12	9·9 × 10·2 × 8·6	0-12V at 5A × 2	5·52	53
17	16	8	8	12	12·1 × 9·9 × 10·2	0-12V at 8A × 2	7·28	60
115	20	10	11	8	14·0 × 9·6 × 11·8	0-12V at 10A × 2	10·39	73
187	30	15	15	8	14·0 × 12·1 × 11·8	0-12V at 15A × 2	13·59	85
226	60	30	32	0	17·2 × 15·3 × 14·0	0·12V at 30A × 2	16·83	*

30 VOLT RANGE

Ref.	Amps	Weight		Size cm.	Secondary Taps	P & P	
No.		lb	oz			£	p
112	0·5	1	4	6·1 × 5·8 × 4·8	0-12-15-20-24-30V	1·81	30
79	1·0	2	4	7·0 × 6·7 × 6·1	,, ,,	2·40	38
3	2·0	3	4	8·9 × 7·7 × 7·7	,, ,,	3·49	38
20	3·0	4	8	9·9 × 8·3 × 8·6	,, ,,	4·53	45
21	4·0	6	4	9·9 × 9·6 × 8·6	,, ,,	5·13	53
51	5·0	6	12	12·1 × 8·6 × 10·2	,, ,,	6·41	53
117	6·0	8	0	12·1 × 9·3 × 10·2	,, ,,	7·15	60
88	8·0	12	0	12·1 × 11·8 × 10·2	,, ,,	9·90	67
89	10·0	13	12	14·0 × 10·2 × 11·8	,, ,,	9·87	73

50 VOLT RANGE

Ref.	Amps.	Weight		Size cm.	Secondary Taps	P & P	
No.		lb	oz			£	p
102	0·5	1	12	7·0 × 6·4 × 6·1	0-19-25-33-40-50V	2·58	30
103	1·0	2	12	8·3 × 7·4 × 7·0	,, ,,	3·38	38
104	2·0	5	8	7·9 × 8·9 × 8·6	,, ,,	4·68	45
105	3·0	6	12	9·9 × 10·2 × 8·6	,, ,,	5·81	53
106	4·0	10	0	12·1 × 10·5 × 10·2	,, ,,	7·60	67
107	6·0	12	0	14·0 × 10·2 × 11·8	,, ,,	12·10	67
118	8·0	18	0	14·0 × 12·7 × 11·8	,, ,,	12·98	85
119	10·0	25	0	17·2 × 12·7 × 14·0	,, ,,	16·99	*

60 VOLT RANGE

Ref.	Amps.	Weight		Size cm.	Secondary Taps	P & P	
No.		lb	oz			£	p
124	0·5	2	4	7·0 × 6·7 × 6·1	0-24-30-40-48-60V	2·33	38
126	1·0	3	4	8·9 × 7·7 × 7·7	,, ,,	3·41	38
127	2·0	6	4	9·9 × 9·6 × 8·6	,, ,,	5·08	45
125	3·0	8	12	12·1 × 9·9 × 10·2	,, ,,	7·52	60
123	4·0	13	12	12·1 × 11·8 × 10·2	,, ,,	8·75	67
40	5·0	12	00	14·0 × 10·2 × 11·8	,, ,,	9·75	73
120	6·0	15	8	14·0 × 12·1 × 11·8	,, ,,	11·30	85
121	8·0	25	00	14·0 × 14·7 × 11·8	,, ,,	15·00	*
122	10·0	25	0	17·2 × 12·7 × 14·0	,, ,,	17·52	*
189	12·0	29	00	17·2 × 14·0 × 14·0	,, ,,	19·98	*

MINIATURE TRANSFORMERS WITH SCREENS

Ref.	mA	Weight		Size cm.	Volts	P & P	
No.		lb	oz			£	p
238	200		2	2·8 × 2·6 × 2·0	3-0-3	1·54	10
212	1A, 1A	1	4	6·1 × 5·8 × 4·8	0-6, 0-6	1·84	30
13	100		4	3·9 × 2·6 × 2·9	9-0-9	1·41	13
235	330, 330		4	4·8 × 2·9 × 3·5	0-9, 0-9	1·56	19
207	500, 500	1	00	6·1 × 5·4 × 4·8	0-8-9, 0-8-9	1·92	30
208	1A, 1A	1	12	7·0 × 6·4 × 6·1	0-8-9, 0-8-9	3·30	38
236	200,200		4	4·8 × 2·9 × 3·5	0-15, 0-15	1·43	19
214	300, 300	1	4	6·1 × 5·8 × 4·8	0-20, 0-20	1·93	30
221	700 (d.c.)	1	8	7·0 × 6·1 × 6·1	20-12-0-12-20	2·17	38
206	1A, 1A	2	12	8·3 × 7·7 × 7·0	0-15-20, 0-15-20	3·46	38
203	500,500	2	4	8·3 × 7·0 × 7·0	0-15-27, 0-15-27	3·00	38
204	1A, 1A	3	4	8·9 × 7·7 × 7·7	0-15-27, 0-15-27	3·85	38

*Carriage via B.R.S.

PLEASE ADD 8% FOR V.A.T.
INCLUDING P. & P.

BARRIE electronics
3, THE MINORIES, LONDON EC3N 1BJ
TELEPHONE: 01-488 3316/8
NEAREST TUBE STATIONS ALDGATE & ALDGATE EAST

ELECTROVALUE

The best of all!

CATALOGUE 7 ISSUE 3

With 25p refund voucher

Up-dated Price and Product Information

112 pages plus cover. As comprehensive and up-to-the-minute as possible. Thousands of items from vast ranges of semi-condutors including I.Cs to components, tools, accessories, technical information and diagrams are included as well as a refund voucher worth 25p for spending on orders list value £5 or more SEND NOW FOR YOUR COPY BY RETURN it's an investment in practical money-saving and reliability! **30p** post paid

PRICES as shown in our latest catalogue (No. 7, issue 3), having been maintained until March 31st, are now reviewed only at 3-monthly intervals as from April 1st. This is instead of making day-to-day price changes.

DISCOUNTS apply on all items except the few where prices are shown NETT. 5% on orders from £5 to £14·99; 10% on orders list value £15 or more.

FREE POST AND PACKING in U.K. for pre-paid mail orders over £2 (except Baxandall cabinets). If under there is an additional handling charge of 10p.

QUALITY GUARANTEE. All goods are sold on the understanding that they conform to maker's specification. No rejects, seconds or sub-standard merchandise.

ELECTROVALUE LTD

All communications to Section 1/5 **,28, ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY TW20 0HB.** Telephone Egham 3603, Telex 264475. *Shop hours: 9–5.30 daily, 9–1 pm Sats.*

NORTHERN BRANCH: 680, Burnage Lane, Burnage, Manchester M19 1NA. Telephone (061) 432 4945. *Shop hours: Daily 9–5.30 pm; 9–1 pm Sats.*

Phoenix Electronics (Solent) Ltd.

139–141 Havant Road,
Drayton, Portsmouth, Hants
PO6 2AA

You already know us—get to know us better! Our catalogue is now only 20p—returnable on your first order.

Our prices on a wide range of semiconductors, i.c's and passive components include VAT, and, despite rising postal costs, carriage is only 20p, too!

THIS MONTH'S BARGAIN OFFER

The Emihus GEMINI 1 POCKET CALCULATOR with the expensive specification—five function operation—percentage key—automatic constant—full floating or fixed decimal point—8 digit display—carrying case—overflow/error indicator.

Our ultra-low price of **£14·95** even includes batteries!

Please send your catalogue—now!

Name ....

Address ....

....

INTERNATIONAL ELECTRONICS UNLIMITED

ORDER DIRECT FROM THE U.S. AND SAVE

SHIPMENT MADE WITHIN 3 DAYS FROM RECEIPT OF ORDER VIA AIR MAIL—POSTAGE PAID

TTL

7400	£ 0·11 p	7448	£ 0·80 p	74150	£ 0·75 p
7401	11	7450	12	74151	60
7402	11	7451	13	74153	71
7403	11	7453	13	74154	1·05
7404	13	7454	14	74155	95
7405	13	7460	11	74156	71
7406	22	7464	21	74157	71
7407	22	7465	21	74161	95
7408	14	7472	22	74163	1·05
7409	14	7473	26	74164	1·25
7410	11	7474	26	74165	1·25
7411	16	7475	41	74166	1·15
7413	35	7476	26	74173	95
7415	22	7483	70	74175	95
7416	22	7485	80	74176	95
7417	22	7486	24	74177	85
7420	11	7489	1·50	74180	80
7422	22	7490	45	74181	2·50
7423	22	7491	71	74182	80
7425	22	7492	44	74184	1·55
7426	23	7493	44	74185	1·45
7427	22	7494	49	74190	95
7430	12	7495	49	74191	95
7432	22	7496	55	74192	90
7437	25	74100	1·25	74193	85
7438	21	74105	60	74194	95
7440	11	74107	27	74195	80
7441	60	74121	32	74196	1·00
7422	55	74122	50	74197	75
7443	55	74123	55	74198	1·70
7444	60	74125	50	74199	1·70
7445	75	74126	50	74200	3·90
7446	85	74141	68		
7447	80	74145	75		

LOW POWER

74L00	£ 0·16 p	74L51	£ 0·16 p	74L90	£ 0·93 p
74L02	16	74L55	18	74L91	80
74L03	16	74L71	18	74L93	89
74L04	18	74L72	27	74L95	89
74L06	18	74L73	38	74L98	1·53
74L10	16	74L74	38	74L164	1·53
74L20	16	74L78	44	74L165	1·53
74L30	16	74L85	85		
74L42	89	74L86	38		

HIGH SPEED

74H00	£ 0·16 p	74H21	£ 0·16 p	74H55	£ 0·20 p
74H01	16	74H22	18	74H60	21
74H04	16	74H30	18	74H61	21
74H08	16	74H40	16	74H62	20
74H10	16	74H50	16	74H74	32
74H11	16	74H52	18		
74H20	16	74H53	20		

8000 SERIES

8091	£ 0·33 p	8214	£ 0·93 p	8811	£ 0·38 p
8092	33	8220	93	8812	60
8095	76	8230	1·42	8822	1·42
8121	49	8520	71	8830	1·42
8123	88	8551	91	8831	1·42
8130	1·20	8552	1·37	8836	27
8200	1·42	8554	1·37	8880	73
8210	1·92	8810	44		

9000 SERIES

9002	£ 0·21 p	9309	£ 0·49 p	9601	£ 0·54 p
9301	63	9312	49	9602	49

Data sheets supplied only on request. Add 25p ea. for data supplied on items less than 50p ea.

CMOS

74C00	£ 0·21 p	74C74	£ 0·63 p	74C162	1·78 p
74C02	30	74C76	93	74C163	1·78
74C04	41	74C107	82	74C164	1·92
74C08	41	74C151	1·59	74C173	1·59
74C10	36	74C154	1·92	74C195	1·65
74C20	36	74C157	1·20	80C95	82
74C42	1·18	74C160	1·78	80C97	82
74C73	85	74C161	1·78		

INTRODUCTORY SPECIALS

5001	12 DIG 4 funct fix dec	Calculator	£ 1·61 p	1103	256 bit RAM MOS	Memory	£ 1·61 p
5002	Same as 5001 exc btry pwr	"	2·71	5260	1024 bit RAM	"	1·61
5005	12 DIG 4 funct w/mem	"	3·81	5261	1024 bit RAM	"	1·61
5725	8 DIG 4 funct chain & dec	"	1·23	5262	2048 bit RAM	"	4·36
5736	18 pin 6 DIG 4 funct	"	2·44	2102	1024 bit static RAM	"	3·81
5738	8 DIG 5 funct K & Mem	"	2·71	5203	2048 bit UV Eras Prom	"	10·88
5739	9 DIG 4 funct (btry sur)	"	2·71	HP50827414	4 digit common cathode	Led	
5311	28 pin BCD 6 dig mux	Clock	2·71		Fits 14 pin DIP – .11 bubble lens	"	1·51
5312	24 pin 1 pps BCD 4 dig mux	"	2·71	MAN 7	Red 7 seg. .270"	"	54
5313	28 pin 1 pps BCD 6 dig mux	"	2·71	MAN 66	Red .6" spaced seg	"	1·92
5314	24 pin 6 dig mux	"	2·71	MAN 6	Red .6" solid seg	"	2·47
5316	40 pin alarm 4 dig	"	3·26	8008	8 bit CPU prime quality		35·36

10% OFF ON ORDERS OVER £10

MEMORIES w/data

1101	256 bit RAM MOS	£ 0·96 p
1103	1024 bit RAM MOS	2·72
5203	2048 bit erasable PROM	13·68
5260	1024 bit RAM Low Power	2·16
7489	64 bit RAM TTL	1·50
8223	Programmable ROM	2·72

CALCULATOR & CLOCK CHIPS w/data

5001	12 DIG 4 funct fix dec	£ 2·17 p
5002	Same as 5001 exc btry pwr	4·36
5005	12 DIG 4 funct w/mem	4·63
MM5725	8 DIG 4 funct chain & dec	1·52
MM5736	18 pin 6 DIG 4 funct	2·72
MM5738	8 DIG 5 funct K & Mem	4·36
MM5739	9 DIG 4 funct (btry sur)	3·81
MM5311	28 pin BCD 6 dig mux	3·81
MM5312	24 pin 1 pps BCD 4 dig mux	3·81
MM5313	28 pin 1 pps BCD 6 dig mux	4·36
MM5314	24 pin 6 dig mux	4·90
MM5316	40 pin alarm 4 dig	4·90

LED & OPTO ISOLATOR

MV10B	Red TO 18	£ 0·14 p
MV50	Axial leads	8
MV5020	Jumbo Vis. Red (Red Dome)	18
	Jumbo Vis. Red (Clear Dome)	18
ME4	Infra red diff. dome	18
MAN 1	Red 7 seg. .270"	1·38
MAN 2	Red alpha num .32"	2·72
MAN 4	Red 7 seg. .190"	1·18
MAN 5	Green 7 seg. .270"	1·62
MAN 6	.6"high solid seg.	3·81
MAN 7	Red 7 seg. .270"	74
MAN 8	Yellow 7 seg. .270"	2·17
MAN 64	.4"high solid seg.	2·45
MAN 66	.6"high spaced seg.	2·55
DL 707	Red 7 seg. .3"	1·18
MCT2	Opto-iso transistor	38

DTL

930	10 p	937	10 p	949	10 p
932	10	944	10	962	10
936	10	946	10	963	10

4000 SERIES RCA EQUIVALENT

CD4001	£0·31 p	CD4013	£0·66 p	CD4023	£0·31 p
CD4009	47	CD4016	69	CD4025	31
CD4010	47	CD4017	1·62	CD4027	74
CD4011	31	CD4019	74	CD4030	52
CD4012	31	CD4022	1·50	CD4035	1·56

LINEAR CIRCUITS

300	Pos V Reg (super 723)	TO-5	£ 0·43 p
301	Hi Perf Op Amp	mDIP TO-5	18
302	Volt follower	TO-5	43
304	Neg V Reg	TO-5	49
305	Pos V Reg	TO-5	52
307	Op AMP (super 741)	mDIP TO-5	20
308	Micro Pwr Op Amp	mDIP TO-5	60
309K	5V 1A regulator	TO-3	91
310	V Follower Op Amp	TO-5 mDIP	65
311	Hi perf V Comp	mDIP TO-5	58
319	Hi Speed Dual Comp	DIP	71
320	Neg Reg 5.2, 12, 15	TO-3	74
322	Precision Timer	DIP	60
324	Quad Op Amp	DIP	1·07
339	Quad Comparator	DIP	92
340T	Pos Volt Reg (6V-8V-12V-15V-18V-24V)	TO-220	1·07
370	AGC/Squelch AMPL	TO-5 or DIP	65
372	AF-IF Strip detector	DIP	44
373	AM/FM/SSB Strip	DIP	1·78
376	Pos. V Reg	mDIP	33
377	2w Stereo amp	DIP	1·47
380	2w Audio Amp	DIP	81
380-8	.6w Audio amp	mDIP	69
381	Lo Noise Dual preamp	DIP	98
382	Lo Noise Dual preamp	DIP	98
550	Prec V Reg	DIP	44
555	Timer	mDIP	54
560	Phase Locked Loop	DIP	1·50
562	Phase Locked Loop	DIP	1·50
565	Phase Locked Loop	DIP TO-5	1·45
566	Function Gen	mDIP TO-5	1·50
567	Tone Decoder	mDIP	1·62
709	Operational AMPL	TO-5 or DIP	16
710	Hi Speed Volt Comp	DIP	21
711	Dual Difference Compar	DIP	16
723	V Reg	DIP	38
739	Dual Hi Perf Op Amp	DIP	65
741	Comp Op AMP	mDIP TO-5	20
747	Dual 741 Op Amp	DIP or TO-5	44
748	Freg Adj 741	mDIP	21
1304	FM Mulpx Stereo Demod	DIP	65
1307	FM Mulpx Stereo Demod	DIP	45
1458	Dual Comp Op Amp	mDIP	38
LH2111	Dual LM 211 V Comp	DIP	1·07
3065	TV-FM Sound System	DIP	38
3075	FM Det-LMTR & Audio preamp	DIP	44
3900	Quad Amplifier	DIP	33
7524	Core Mem Sense AMPL	DIP	1·04
7534	Core Mem Sense Amp	DIP	1·42
8864	9 DIG Led Cath Drvr	DIP	1·37
75451	Dual Perepheral Driver	mDIP	21
75452	Dual Peripheral Driver	mDIP	21
75453	(351) Dual Periph. Driver	mDIP	21
75491	Quad Seq Driver for LED	DIP	50
75492	Hex Digit Driver	DIP	55

Data sheets supplied only on request. Add 25p ea. for data supplied on items less than 50p ea.

ALL ITEMS ARE NEW, MARKED, TESTED FUNCTIONAL — SATISFACTION GUARANTEED

The prices as listed are in British pounds and pence. Send bank cheque (U.S. funds) with order. If international postal money order is used, send receipt with order. Minimum order £2·50p.

INTERNATIONAL ELECTRONICS UNLIMITED
P.O. BOX 1708 MONTEREY, CA. 93940 USA
PHONE (408) 659-3171

RTVC

*COMPLETE STEREO SYSTEM

Scotland P & P Surcharge
System 1a £1.75 System 2 £3.50

System 1a. £62.00

40 Watt Amplifier. Viscount III – R102 now 20 watts per channel (40 watts peak).
All systems include:
Viscount III amplifier – volume, bass, treble and balance controls, plus switches for mono/stereo, on/off function and bass and treble filters. Plus headphone socket.
Specification:
20 watts per channel into 8 ohms 40W peak. Total distortion @10W @1kHz 0.1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV at 1kHz into 47K. equalised within ∓1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to −17dB @60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to −12dB @15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max.) −58dB. Crosstalk better than 35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13¾"×9"×3¾".
Garrard SP 25 deck with magnetic cartridge, de luxe plinth and cover.
Two Duo Type IIa matched speakers – Enclosure size approx. 19¼"×9½"×7¾" in simulated teak. Drive unit 13"×8" with 3" tweeter. 15 watts handling.
Complete System with these speakers £62.00 + £5.50 p & p.

System 2. £82.00

Viscount III amplifier (As System 1a)
Garrard SP 25 deck (As System 1a)

Two Duo Type III matched speakers – Enclosure size approx. 27"×13"×11½" Finished in teak simulate. Drive units 13"×8" bass driver, and two 3" (approx.) tweeters. 20 watts RMS, 8 ohms frequency range – 20 Hz to 18,000 Hz.
Complete System with these speakers £82.00 + £6.50 p & p.

PRICES: SYSTEM 1a

Viscount III R102 amplifier	£27.00+£1.60 p & p
2 Duo Type IIa speakers	£26.00+£5.50 p & p
Garrard SP 25 with Mag. cartridge de luxe plinth and cover	£21.00+£2.80 p & p
total: £74.00	

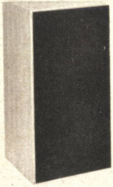
Available complete for only: £62.00
+£5.50 p & p

PRICES: SYSTEM 2

Viscount III R102 amplifier	£27.00+£1.60 p & p
2 Duo Type III speakers	£39.00+£6.40 p & p
Garrard SP 25 with Mag. cartridge de luxe plinth and cover	£21.00+£2.80 p & p
total: £87.00	

Available complete for only: £82.00
+£6.50 p & p

EMI SPEAKERS AT FANTASTIC REDUCTIONS



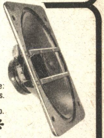
LE-4 SPEAKERS

Superb performance and beautifully finished in selected teak veneers. A professional standard four-way speaker system giving 25 watts RMS power handling. Bass unit is 14"×9" with 8"×5" unit for mid-range and twin 3" high frequency units to give monitor type quality and performance.
Specification – Size 33"×14"×16" approx. Impedance 8 ohms. Power handling 25W RMS. (Peak 50 watts.) Frequency range 35 Hz–20 KHz.

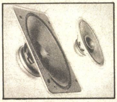
Our Price £29.00
(normally £56.97) +£5 p & p.

EMI 350 KIT

System consists of a 13"×8" approx. woofer with a 3" tweeter, crossover components and circuit diagram. Frequency response: 20 Hz to 20 KHz. Power handling 15 watts RMS into 8 ohms. (Peak 30 watts.)
Complete with crossover Components and circuit diagram **£5.50** +£1 p & p.



20 WATT SPEAKER SYSTEM*

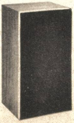


System consists of a 13"×8" (approx.) eliptical woofer unit with a 8"×5" (approx.) mid-range unit incorporating parasitic tweeter and crossover components and circuit diagram
Technical Specification: Bass Unit: Flux density – 100 K, speech coil – 1½". Cone. Triple laminated paper with P.V.C. surround. Mid-Range Unit: Flux density – 33 K, speech coil – 1" with parasitic tweeter. Power handling: 20 watts RMS, impedance – 8 ohms, frequency response – 20 Hz to 18,000 Hz.

Our Price £7.50
Complete +£1.35 p & p.

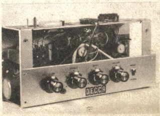
EASY TO BUILD SPEAKER KITS

These superb simulated teak-finished speaker kits have been specially designed by RT-VC for the cost-conscious hi-fi enthusiast who wants top quality speakers but doesn't want to spend the earth. Built to EMI's exacting specification, these new RT-VC speaker kits (350 type kit) incorporate 13"×8" woofer, 3¼" tweeter and matching crossover.
Easily put together with just a few basic tools.
Specification (each speaker): Impedance 8 ohms. Power handling 15 watts RMS (30 watts peak). Response 20–20,000Hz. Size 20"×11"×9½" approx. Comparable built units (EMI LE3) sold elsewhere for over £45 pair.



£18.95 pair complete
+£4.50 p & p.
Complete with crossover Components and circuit diagram

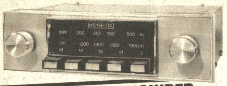
DECCA STEREO AMPLIFIER CHASSIS



Specification: 4+4 watts into 8 ohms. Input Sensitivity 4mV into 47K (for magnetic cartridges). AC Mains only 240V. Controls – volume, bass, treble, on/off, mono/stereo switch. Chassis size 11"×5½"×3¼" approx.

£5.95+£1 p & p.

PUSH BUTTON CAR RADIO KIT– THE TOURIST TT*



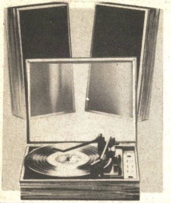
NO SOLDERING REQUIRED

NOW BUILD YOUR OWN
PUSH BUTTON CAR RADIO

Easy to assemble construction kit comprising fully completed and tested printed circuit board on which no soldering is required. All connections are simple push fit type making for easy assembly.
Fine tuning push button mechanism is fully built and tested to mate with printed circuit board.
TECHNICAL SPECIFICATION: (1) **Output** 4 watts RMS output. For 12 volt operation on negative or positive earth. (2) **Integrated circuit** output stage, pre-built three stage IF Module.

Controls volume manual tuning and five push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands.
Size chassis 7" wide 2" high
and $4\frac{3}{4}$" deep approx. **£8.00** + 90p. p & p.
Speaker including baffle and fixing strip £1.65 +37p p & p. Car Aerial Recommended – fully retractable £1.37+32p p & p.
The Tourist I Kit For the experienced constructor. If you can solder on a printed circuit board you can build this model. Same technical specification as Tourist TT. **Price £7.00** + 90p p & p.

*STEREO 21 QUALITY SOUND FOR LESS THAN £20.00



Stereo 21, easy to assemble audio system kit. No soldering required.
The unit is finished in white P.V.C. and the acrylic top presents an unusually interesting variation on the modern deck plinth.
Includes – **BSR 3 speed deck,** automatic, manual facilities together with stereo cartridge.
Two speakers with cabinets.
Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.
Specifications – For the technically minded:
Input sensitivity 600mV. Aux. input sensitivity 120mV. Power output 2.7 watts per channel. Output impedance 8–15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs – radio, tape, etc., and outputs for taping discs.
Overall Dimensions. Speakers approx $15\frac{1}{2}'' \times 8'' \times 4''$. Complete deck and cover in closed position approx. $15\frac{1}{2}'' \times 12'' \times 6''$.

Complete only £19.95 + **£2.60 p & p.**

Extras if required. Optional Diamond Styli **£1.37.**
Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance. **£5.00.**

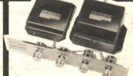
*DISCO AMPLIFIER

Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties. Output 20 watts RMS into 8 ohms (suitable for 15 ohms).
Inputs *4 electrically mixed inputs. *3 individual mixing controls. *Separate bass and treble controls common to all 4 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State circuitry. *Attractive styling.
INPUT SENSITIVITIES – Input – 1). Crystal mic. guitar or moving coil mic, 2 and 10mV. (Selector switch for desired sensitivity.) – Inputs – 2), 3), 4). Medium output equipment – ceramic cartridge, tuner, tape recorder, organs, etc. – all 250mV sensitivity. AC Mains, 240V operation. Size approx: $12\frac{1}{2}'' \times 6'' \times 3\frac{1}{2}''$.
£17.00 + £1.15 p & p.

*8 TRACK HOME CARTRIDGE PLAYER

Elegant self selector push button player for use with your stereo system. Compatible with Viscount III system, Unisound module and the Stereo 21. Technical specification Mains input, 240V, Output sensitivity 125mV. Comparable unit sold elsewhere at £24.00 approx. Yours for only
£12.95 + £1.45 p & p.

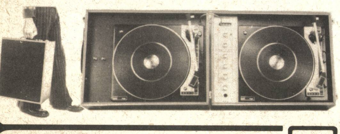
BUILD YOUR OWN STEREO AMPLIFIER *



For the man who wants to design his own stereo – here's your chance to start, with Unisound – pre-amp, power amplifier and control panel. No soldering – just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum. 240V. AC only.
Also available with 2 speakers (7" x 4") £9 +£1.50 p & p. **£7.64** + **90p p & p.**

PORTABLE DISCO CONSOLE*

INCORPORATES: Pre-Amp with full mixing facilities, including switched input for mic with volume control, switched input for auxiliary with volume control, bass and treble controls, volume control and blend control for turntables. Two B.S.R. MP60 type single play professional series decks, fitted with crystal cartridges.



TECHNICAL SPECIFICATION:
Pre-amp – Output – 200mV. Auxiliary inputs – 200mV and 750mV into 1 meg. Mic input – 6mV into 100K. 240 volt operation. **Turntables capacity** – 7", 10" or 12" records. **Rumble, wow and flutter** Rumble Better than –35dB. Wow Better than 0.2%. Flutter Better than 0.06% (Gaumont kalee meter).
Finish – Satin black mainplate with black turntable mat inlaid with brushed aluminium trim. Tonearm and controls in black and brushed aluminium.

Console size –
Unit Closed – $17\frac{3}{4}'' \times 13\frac{3}{4}'' \times 8\frac{3}{4}''$(app.)
Unit Open – $35\frac{3}{4}'' \times 13\frac{3}{4}'' \times 4\frac{3}{8}''$ (app.)
This disco console is ideally matched for the Reliant IV and Disco 50 or any other quality amplifier.
The unit is finished in black PVC with contrasting simulated teak edging, diamond spun control knobs with matching control panel.

Yours for only
£49.00 + £5.60 p. & p.

BARCLAYCARD
Buy it with Access

DO NOT SEND CARD
Just write your order giving your credit card number

Mail orders to Acton. Terms C.W.O. All enquiries stamped addressed envelope. Goods not despatched outside U.K. Leaflets available for all items listed thus * Send stamped addressed envelope. All items subject to availability. Prices correct at 1st March 1975 and subject to change without notice.
All prices include V.A.T. at 8% rate.

R T V C

21D HIGH STREET, ACTON, LONDON W3 6NG
323 EDGWARE ROAD, LONDON W2
Personnal Shoppers **EDGWARE RD**: 9 a.m.–5.30p.m. Half day Thurs.
ACTON: 9.30a.m.–5p.m. Closed all day Wed.

GIRO NO. 331 7056. Access accepted.
C.W.O. only. P. & P. 10p on orders below £5
Discount: £10–10%, £20–15% (except net items)
Export Order enquiries welcome (VAT free)

Official Orders accepted from
Educational & Government Departments
ALL PRICES INCLUDE VAT AT 8%

SPECIAL RESISTOR KITS (Prices include post & packing)

10E12 ¼W KIT: 10 of each E12 value, 22 ohms—1M, a total of 570 (CARBON FILM 5%), **£3·58** net
10E12 ½W KIT: 10 of each E12 value, 22 ohms—1M, a total of 570 (CARBON FILM 5%), **£3·77** net
25E12 ¼W KIT: 25 of each E12 value, 22 ohms—1M, a total of 1425 (CARBON FILM 5%), **£8·19** net
25E12 ½W KIT: 25 of each E12 value, 22 ohms—1M, a total of 1425 (CARBON FILM 5%), **£8·28** net
5E12 ½W KIT: 5 of each E12 value, 10 ohms—1M, a total of 305 (METAL FILM 5%), **£2·80** net
Due to current world shortages, resistor kits may contain some wattage and value substitutions.

MULLARD POLYESTER CAPACITORS C280 SERIES
250V P.C. Mounting: 0·01µF, 0·015µF, 0·022µF, 0·033µF, 0·047µF, **3½p.** 0·068µF, 0·1µF, **4½p.** 0·15µF, **4½p.** 0·22µF, **5½p.** 0·33µF, **8p.** 0·47µF, **9p.** 0·68µF, **12p.** 1µF, **15p.** 1·5µF, **23p.** 2·2µF, **26p.**

MULLARD POLYESTER CAPACITORS C296 SERIES
400V, 0·001µF, 0·0015µF, 0·0022µF, 0·0033µF, 0·0047µF, **2½p.** 0·0068µF, 0·01µF, 0·015µF, 0·022µF, 0·033µF, **3½p.** 0·047µF, 0·068µF, 0·1µF, **4½p.** 0·15µF, **6½p.** 0·22µF, **8½p.** 0·33µF, **12p.** 0·47µF, **14p.**
160V: 0·01µF, 0·15µF, 0·022µF, **3p.** 0·047µF, 0·068µF, **3½p.** 0·1µF, **4½p.** 0·15µF, **5p.** 0·22µF, **5½p.** 0·33µF, **6½p.** 0·47µF, **8½p.** 0·68µF, **12p.** 1µF, **14p.**

MINIATURE CERAMIC PLATE CAPACITORS
50V: (pF) 22, 27, 33, 39, 47, 56, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820, 1K, 1K5, 2K2, 3K3, 4K7, 6K8, (µF) 0·01, 0·015, 0·022, 0·033, 0·047, **2½p.** each. 0·1, 30V, **5p.**

POLYSTYRENE CAPACITORS 160V 5%
(pF) 10, 15, 22, 33, 47, 68, 100, 150, 220, 330, 470, 680, 1000, 1500, 2200, 3300, 4700, 6800, 10,000, **4½p.**

RESISTORS
CF—High Stab Carbon Film, 5% MF—High Stab Metal Film, 5%.

W.	Type	Range	1–99	100–499	500–999	1000 +	Size mm
⅛	CF	12–1M	1	0·75	0·60	0·55	2·4x7·5
¼	CF	22–2M2	1	0·75	0·60	0·55	3·9x10·5
½	CF	22–1M	1	0·75	0·60	0·55	5·5x16
¼	MF	10–2M7	2	1·54	1·32	1·1	3x7
½	MF	10–2M2	2	1·43	1·21	0·99	4·2x10·8
1	MF	10–10M	3	1·98	1·81	1·65	6·6x13
2	MF	10–10M	4·5	3·52	3·08	2·75	8x17·5

For value mixing prices, please refer to our catalogue. (Price in pence each).
VALUES AVAILABLE—E12 Series only. (Net prices above 100.)

PRESET SKELETON POTENTIOMETERS
MINIATURE 0·25W Vertical or horizontal **6p** each 1K, 2K2, 4K7, 10K, etc. up to 1M Ω
SUB-MIN 0·05W Vertical, 100 Ω to 220K Ω **5p** each.

B. H. COMPONENT FACTORS LTD.

(P.E.), LEIGHTON ELECTRONICS CENTRE, 59 NORTH STREET, LEIGHTON BUZZARD, LU7 7EG. Tel.: Leighton Buzzard 2316 (Std. Code 05253). CATALOGUE No. 3, 20p.

Miniature Mullard Electrolytics

1·0µF	63V	6½p	68µF	16V	6½p
1·5µF	63V	6½p	68µF	63V	12p
2·2µF	63V	6½p	100µF	10V	6½p
3·3µF	63V	6½p	100µF	25V	6½p
4·0µF	40V	6½p	100µF	63V	14p
4·7µF	63V	6½p	150µF	16V	6½p
6·8µF	63V	6½p	150µF	63V	15p
8·0µF	40V	6½p	220µF	6·4V	6½p
10µF	16V	6½p	220µF	10V	6½p
10µF	25V	6½p	220µF	16V	8p
10µF	63V	6½p	220µF	63V	21p
15µF	16V	6½p	330µF	16V	12p
15µF	63V	6½p	330µF	63V	25p
16µF	40V	6½p	470µF	6·4	9p
22µF	25V	6½p	470µF	40V	20p
22µF	63V	6½p	680µF	16V	15p
32µF	10V	6½p	680µF	40V	25p
33µF	16V	6½p	1000µF	16V	20p
33µF	40V	6½p	1000µF	25V	25p
32µF	63V	6½p	1500µF	6·4V	15p
47µF	10V	6½p	1500µF	16V	25p
47µF	25V	6½p	2200µF	10V	25p
47µF	63V	8p	3300µF	6 4V	26p

VEROBOARD	0·1	0·15
2½ x 5″	36p	36p
2½ x 3¾″	33p	25p
3¾ x 5″	42p	46p
3¾ x 3¾″	36p	36p
2½ x 1″	9p	9p
2½ x 5″ (Plain)	—	19p
2½ x 3¾″ (Plain)	—	16p
5 x 3¾″ (Plain)	—	29p
Insertion tool	73p	73p
Track Cutter	56p	56p
Pins, Pkt. 25	22p	22p

TRANSISTORS

AC127	16½p	BC212L	12p
AC128	22p	BC213L	12p
BC107	11p	BC214L	17p
BC108	12p	OC44	18p
BC109	13p	OC71	13p
BC148	12p	OC81	16p
BC149	12p	OC170	23p
BC182L	12p	TIS43	33p
BC183L	12p	2N2926	11p
BC184L	13p	2N3702	11p

POTENTIOMETERS
Carbon Track 5K Ω to 2M Ω, log or lin (and 1K lin). Single, **16½p** Dual Gang **46p.** Log single with switch **26p.** Slider Pots. 10K, 100K, 500K, semi log 30mm, **34p.** 45mm, **47p.** 60mm, **55p.**

DIODES	
IN4001	6½p
IN402	7½p
IN4003	9p
IN4400	9p
IN4005	12p
IN4006	14p
IN914	1p
IN916	7p
BA100	10p
OA5	42p
OA47	9p
OA81	11p
OA200	8p

PLUGS	
Din 2 Pin.	12p
3 Pin	13p
5 Pin 180°	16p
Std. Jack	20p
2·5mm jack	13p
Phono	6p
SOCKETS	
Din 2 Pin	10p
3 Pin	10p
5 Pin 180°	12p
Std. Jack	15p
2·5mm Jack	13p
Phono	6p

ELECTROLYTIC CAPACITORS. Tubular & Large Cans
(uF/V): 1/25, 2/25, 4/25, 4·7/10, 5/25, 8/25, 10/10, 10/50, 16/25, 22/63, 25/25, 25/50, 32/25, 50/25, 100/10, 100/25, **6½p.** 50/50, **8p.** 100/50, 200/25, **11p.** 250/50, **18p.** 500/10. **11p.** 500/25, **15p.** 500/50, **18p.** 1000/10, **15p.** 1000/25, **22p.** 1000/50, **40p.** 2000/10, **20p.** 1000/100. **88p.** 2000/25, **30p.** 2000/100, **93p.** 2500/25, **38p.** 2500/50, **61p.** 5000/25, **65p.** 5000/50, **£1·08.**

HI-VOLT: 4/350, **14p.** 8/350, **19p.** 100/100, **20p.** 16/350, **22p.** 16/450, **23p.** 32/350, **33p.** 50/250, **20p.** 100/250, **30p.**

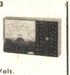
METALLISED PAPER CAPACITORS
250V: 0·05µF, 0·1µF, **6p.** 0·25, **6p.** 0·5µF, **7½p.** 1µF, **9p.** 500V: 0·025, 0·05, **6p.** 0·1, **6p.** 0·25, **7½p.** 0·5, **9p.** 1000V: 0·01, **11p.** 0·022, **13p.** 0·047, 0·1, **15p.** 0·22, **23p.** 0·47, **34p.**

PLEASE NOTE OUR NEW ADDRESS.

Our New Electronics Centre is now open in Leighton Buzzard and all callers are welcome. As well as our normal stock of over 2,000 products we have a large range of surplus bargains and calculators, etc. Open 6 days. 9-12.30. 1.30-5 p.m.

NEW KIT
5E12 ⅛W Metal Film.
5 each value 10 Ω-1M,
total of 305 **£3·25**

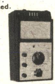
MULTIMETER U4323



22 Ranges plus AF/IF Oscillator 20,000 Ω/Volt.
Vdc—0·5—1000V in 7 ranges
Vac—2·5—1000V in 6 ranges
Idc—0·05—500mA in 5 ranges
Resistance—5 Ω—1M Ω in 4 ranges.
Accuracy—5% of F.S.D.
OSCILLATOR—1 KHz and 465KHz (A, M.) at approx. 1 Volt.
Size—160 x 97 x 40mm.
Supplied complete with carrying case, test leads and battery.
PRICE **£8·30** net P. & P. 25p.

U4323

MULTIMETER U4341



27 Ranges plus Transistor Tester.
16,700 Ω/Volt. Overload protected.
Vdc—0·3—900V in 8 ranges.
Vac—1·5—750V in 6 ranges.
Idc—0·06—600mA in 5 ranges.
Iac—0·3—300mA in 4 ranges.
Resistance—2K Ω—2M Ω in 4 ranges. Accuracy—dc—2½%.
ac—4% of F.S.D.
hfe—10—350 in 2 ranges.
Size—115 x 215 x 90mm.
Complete with steel carrying case, test leads, and battery.
PRICE **£11·30** net P. & P. 30p.

U4341

NEW CAPACITOR KITS

C280 Kit—PC Mounting polyester 250V. 5 of each value: 0·01 0·022, 0·047, 0·1, 0·22µF. 2 of 0·47, 1µF. **£1·30** net.
C296 Kit—Tubular polyester, 400V. 5 of each value: 0·01, 0·022, 0·047, 0·1, 0·22µF. 2 of 0·47µF. **£1·30** net.
Ceramic Kit—square plaquette 50V. 5 each value: 22, 33, 47, 100, 220, 330, 470, 1000pF, 2200, 4700pF, 0·1µF. **£1·30** net.
250V Paper kit—Tubular metal case. 3 of each value: 0·05, 0·1, 0·25, 0·5, 1µF. **90p** net.
500V Paper Kit—Tubular metal case. 3 of each value: 0·025, 0·05, 0·1, 0·25, 0·5µF. **90p** net.
1000V Paper Kit—Tubular metal case. 3 each value: 0·01, 0·025, 0·05, 0·1µF. **£1·10** net.

MULTIMETER U4324

34 Ranges. High sensitivity.
20,000 Ω/Volt. Overload protected.
Vdc—0·6—1200V in 9 ranges.
Vac—3—900V in 8 ranges.
Idc—0·06—3A in 6 ranges.
Iac—0·3—3A in 5 ranges.
Resistance—25 Ω—5M Ω in 5 ranges.
Accuracy—dc and R—2½% of F.S.D.
ac and db—4% of F.S.D.
Size—167 x 98 x 63mm.
Supplied complete with storage case, test leads, spare diode, and battery.
PRICE **£9·95** net P. & P. 25p.

U4324

MULTIMETER U4313

33 ranges. Knife edge with mirror scale.
20,000 Ω/Volt. High accuracy. mVdc—75mV.
Vdc—1·5—600V in 9 ranges.
Vac—1·5—600V in 9 ranges.
Idc—60—120 microamps in 2
Idc—0·6—1500mA in 6 ranges.
Iac—0·6—1500mA in 6 ranges.
Resistance—1K Ω—1M Ω in 4 ranges.
db scale—–10 to + 12db.
Accuracy—dc—1½%, ac—2½%
Size—115 x 215 x 90mm.
Complete with steel carrying case, test leads, and battery.
PRICE **£13·40** net P. & P. 30p.

U4313

S-DeC	
S-DeC	£2·14
T-DeC	£3·92
µDeC "A"	£4·30
µDeC "B"	£7·53
2 DeC	£4·72

ANTEX	
CCN240	£2·43
CN240	£2·01
X25	£2·01

MULTIMETER U435

32 ranges. High sensitivity. 20,000 Ω/Volt.
Vdc—75mV—1000V in 8 ranges
Vdc—2·5—1000V in 7 ranges.
Idc—0·001—2·5A in 6 ranges.
Iac—0·005—2·5A in 5 ranges.
Resistance—3-300K in 3 ranges
Capacitance scales 0-0·5µF.
Accuracy—dc and R—2½% of F.S.D.
ac and C—4% of F.S.D.
Size—205 x 110 x 84mm.
Complete with steel carrying case, test leads and battery.
PRICE **£9·45** net P. & P. 25p.

INVERTORS

240V—50Mz from your 12V car battery.
25W—**£3·90** + 30p p & p.
40W—**£6·80** + 55p p & p.
75W—**£9·96** + 75p p & p.

150W—**£18·30** + 80p p & p.
30W (12V)—**£28·80** + £1·05 p & p.
300W (24V)—**£22·70** + £1·05 p & p.

All above invertors are in kit form but may be purchased built up and ready for use. Price list sent on receipt of stamped addressed envelope.

P.W. AUTOMATIC EMERGENCY SUPPLY

250V—50Hz—150W invertor with built in battery charger, in event of power failure switches over automatically from battery charging to invertor operation. Cct. as appeared in Dec. 73 *P.W.* Complete kit of parts (excluding meter) **£22·50** + £1·10 p & p.

COMPLETE FLUORESCENT LIGHT INVERTOR KIT

8W—12V—Fluorescent light, suitable for tents, caravans, houses, boats and secondary lighting for factories, hotels etc. 12in—8W **£2·90** + 25p p & p. 21in—13W **£3·30** + 30p p & p.

TRANSFORMERS AND COILS

Both high volume and small order capacity available for Mains, R.F., and I.F. Transformers. Before you buy elsewhere let us quote you and see what you save. V.A.T. at 8% included.

TRADE AND EXPORT ENQUIRIES WELCOMED

ASTRO ELECTRONICS, 10A SPRINGBANK ROAD, CHESTERFIELD, DERBYS.

'CUB' MINI-BLOWTORCH
up to 2,500° F

Vest pocket size, yet will braze, silver-solder small jewellery items, etc. soft solder, strip paint, putty, burn-off oiled spark plugs, etc. Burns up to 1 hr on tiny gas cylinder. Complete with 2 cylinders and instruction book.

£2·92 Inc. VAT, P. & P. (extra cylinders **60p** per 2)
1010 Soft-solder bit for Cub **92p** inc.

'CRAFTSMAN'S' TORCHES
up to 6,000° F

A range of mini-torches for all gases, incl. Oxy/Acetylene. Operate from standard gas cyls, or our own mini-packs, for all ultra-fine welding, brazing, fusion or cutting, incl. steel, glass, ceramics, in labs. or workshops. 0·002–1in. capacity. Send for leaflet and price list.

MICROFLAME (UK) LIMITED
'Freepost', Rickinghall, Diss, Norfolk, LP22 1BR. Tel. Botesdale (037-989) 555

Sinclair Project 80

For elegant, versatile, stereo hi-fi systems designed and built by you!

Until recently, if you wanted a first-class hi-fi system you had two ways to get it.

You could buy the individual electronic components and build a system from scratch. If you were an electronics genius – fine.

Or you had to buy ready-made units. Expensive – and dull. About the only creative pleasure you'd get would be matching your amp and your speakers, or making your speaker enclosures.

So what's new?

A comprehensive hi-fi system, combining the enjoyment and satisfaction of build-it-yourself (without too much struggle) . . . a real value-for-money feeling . . . and results of the highest quality.

It's the new Sinclair Project 80.

How does Sinclair Project 80 work?

Project 80 is a comprehensive set of hi-fi modules, or sub-assemblies. Amps . . . pre-amps . . . FM tuner . . . stereo decoder . . . control units . . . everything you need to assemble hi-fi units. They're all designed to look alike and they're all completely compatible with each other. Simply decide on the specifications of the unit you want to build . . . buy the necessary modules . . . connect them . . . and house them.

No need to buy everything at once for your eventual set-up. All the modules are designed so that you can add to them as your system grows – whether or not it's based on Project 80.

This applies to refinements, like filters . . . to up-grading, adding a second set of amps, say, for greater output . . . or to real innovation, like quad. (Add a Project 80 quad decoder, a power supply, a pair of amps, and a pair of speakers – and your stereo's gone quad.)

Is it difficult to build?

Not at all. The modules are complete in themselves. All you do is connect them to your turntable . . . your speakers . . . or to each other. It's absorbing, but if you can solder wires to a 5-pin DIN plug, you can build a complete system with Project 80.

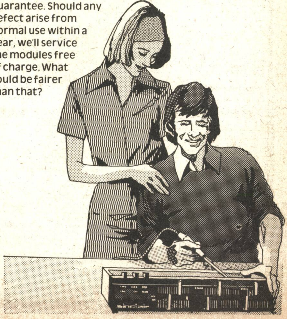
And if you're not so hot with a soldering iron? Use Project 805. Project 805 uses Project 80 modules, but provides special clip-on tagged wire connections – absolutely *no* soldering required.

And, of course, both Project 80 and Project 805 come complete with instructions for easy, step-by-step assembly. But if you do run into problems, just call our Consumer Advisory Service who are always happy to help.

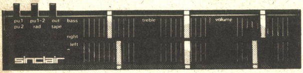
OK. Where do I go from here?

Over the page! There you'll see for yourself the exacting specifications to which Sinclair Project 80 modules are made, and you'll see some suggested systems.

As you skim the suggestions, remember all Project 80 modules are backed by the remarkable no-quibble Sinclair guarantee. Should any defect arise from normal use within a year, we'll service the modules free of charge. What could be fairer than that?



Choose the Project 80 modules that are right for you.

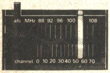


Project 80 pre-amp/control unit

The control centre of Project 80. With its distinctive white-on-matt-black styling and plastic control sliders, it's a pleasure to look at, as well as to use.

Specification
(9½ in x 2 in x ¾ in.) Separate slider controls on each channel for treble, bass and volume. **Inputs:** *PU* magnetic – 3 mV (RIAA corrected), ceramic – 350 mV; *Radio* 100 mV; *Tape* 30 mV. **S/N ratio:** 60 dB. **Frequency range:** 20 Hz to 15 kHz ± 1 dB. **Outputs:** 100 mV and tape plus AB monitoring. **Press buttons** for PU, radio and tape. **Operating voltage:** 20 V – 35 V.

Price: £13.95 + VAT

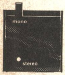


Project 80 FM tuner

Excellent reception from a tuner only 3½ in long x ¾ in deep! Styled to match Project 80 control unit.

Specification
(3½ in x 2 in x ¾ in.) Tunes 87.5 MHz to 108 MHz. **Detector:** IC balanced coincidence (IC equivalent to 26 transistors). **Distortion:** 0.3% at 1 kHz for 30% modulation. **Sensitivity:** 5 μV for 30 dB signal to noise. **Output:** 100 mV for 30% modulation. **Aerial imp:** 75 Ω or 240-300 Ω. **Features:** dual Varicap tuning, 4-pole ceramic filter, switchable AFC. **Operating voltage:** 23 V – 30 V.

Price: £13.95 + VAT

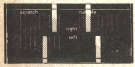


Project 80 stereo decoder

Designed for use with Project 80 FM tuner. Sold separately to keep down the price of a mono FM system, but also to make the stereo decoder available for use with existing mono FM tuners.

Specification
(1¾ in x 2 in x ¾ in.) 1 IC equivalent to 19 transistors. LED stereo indicator glows red.

Price: £8.95 + VAT

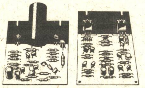


Project 80 active filter unit

Eliminates scratch and rumble (high and low-frequency noise).

Specification
(4¼ in x 2 in x ¾ in.) **Voltage gain:** –0.2 dB. **Frequency response:** filter at zero: 36 Hz – 22 kHz; HF (scratch) out: variable 22 kHz to 5.5 kHz, 12 dB/octave slope; LF (rumble) out: –28 dB at 28 Hz, 9 dB/octave slope.

Price: £7.45 + VAT



Project 80 power amplifiers

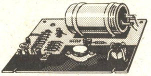
Two different amplifiers, designed to be used separately or combined, with Project 80 modules or as add-ons to existing equipment. Protected against short circuits and damage from mis-use.

Z40 Specification
(2¼ in x 3 in x ¾ in.) 8 transistors. **Input sensitivity:** 100 mV. **Output:** 12 W RMS continuous into 8 Ω (35 V). **Frequency response:** 30 Hz – 100 kHz ± 3 dB. **S/N ratio:** 64 dB. **Distortion:** 0.1% at 10 W into 8 Ω at 1 kHz. **Voltage requirements:** 12 V – 35 V. **Load imp:** 4 Ω – 15 Ω; safe on open circuit. Protected against short circuit.

Price: £5.95 + VAT

Z60 Specification
(2¼ in x 3¾ in x ¾ in.) 12 transistors. **Input sensitivity:** 100 mV – 250 mV. **Output:** 25 W RMS continuous into 8 Ω (50 V). **Frequency response:** 10 Hz to more than 200 kHz ± 3 dB. **S/N ratio:** better than 70 dB. **Distortion:** less than 0.1% at 12 W into 4 Ω at 1 kHz. **Voltage requirements:** 12 V – 50 V. **Load imp:** 4 Ω min; max safe on open circuit. Protected against short circuit.

Price: £7.45 + VAT



Power supply units

Range of power supply units to match desired specification of final system.

PZ5 Specification
Unstabilised. 30 V output. Including mains transformer.

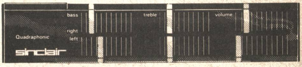
Price: £5.95 + VAT

PZ6 Specification
Stabilised. 35 V output. Including mains transformer.

Price: £8.95 + VAT

PZ8 Specification
Stabilised. Output adjustable from 20 V to 60 V approx. Re-entrant current limiting makes damage from overload or even shorting virtually impossible. Without mains transformer.

Price: £8.45 + VAT



Project 80 SQ quadraphonic decoder

Combines with and exactly matches Project 80 control unit for true quadraphonics. This unit is based on the CBS SQ system and is a complete quadraphonic decoder, rear channel pre-amp and control unit.

Specification
(9½ in x 2 in x ¾ in.) Connects with tape socket on Project 80 control unit or similar facility on any stereo amplifier. Separate slider controls on each channel for treble, bass and volume. **Frequency response:** 15 Hz to 25 kHz ± 3 dB. **Distortion:** 0.1%. **S/N ratio:** 58 dB. **Rated output:** 100 mV. **Phase shift network:** 90 ± 10 100 Hz to 10 kHz. **Operating voltage:** 22 V – 35 V.

Price: £18.95 + VAT

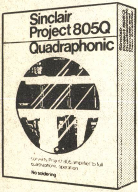
Some system suggestions from Sinclair

Project 805 amplifier kit

Contains following Project 80 units:

Project 80 control unit
2 x Z40 power amplifier modules
1 x PZ5 power supply unit
Masterlink unit
On/off switch
plus pre-cut wiring loom with clip-on tagged wire connections, nuts and bolts, instruction manual.

Price: £39.95 + VAT


Sinclair
Project 805Q
Quadraphonic
Converts Project 805 amplifier to full quadraphonic operation
No soldering

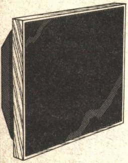
Project 805Q quadraphonic add-on kit

Converts your existing stereo hi-fi system to quad using solderless connections.

Contains following Project 80 units:

Project 80 SQ quad decoder/rear channel pre-amp and control unit
2 x Z40 power amps
PZ5 power supply unit
Masterlink unit
On/off switch
plus pre-cut wiring loom with clip-on tagged wire connections, nuts and bolts, instruction manual.

Price: £44.95 + VAT



Sinclair Q16 speaker

Original and uniquely designed speaker of outstanding quality.

Specification
(10⅜ in square x 4¾ in deep.) Pedestal base. All-over black front. Teak surround. Balanced sealed sound chamber. Special driver assembly. **Frequency response:** 60 Hz to 16 kHz. **Power handling:** up to 14 W RMS. **Impedance:** 8 Ω.

Price: £8.95 + VAT

1. Quadraphonic system: 25 W per channel RMS
Pre-amp/control unit + quadraphonic decoder + 4 x Z60 amps + 2 x PZ8 mains power supplies + (2 x mains transformers) + (4 x equivalent speakers) + (turntable). Total Project 80 cost: £79.60 + VAT.

2. Stereo amplifier: 12 W per channel RMS
Pre-amp/control unit + 2 x Z40 amps + PZ6 power supply + 2 x Q16 speakers. Total Project 80 cost: £52.70 + VAT.

3. Stereo tuner/amplifier: 12 W per channel RMS
Pre-amp/control unit + FM tuner + stereo decoder + 2 x Z40 amps + PZ6 power supply + 2 x Q16 speakers. Total Project 80 cost: £75.60 + VAT.

Other applications

4. PA system
(Mic) + pre-amp/control unit + Z40 amp + PZ6 power supply + 2 x Q16 speakers. Total Project 80 cost: £46.75 + VAT.

5. Convert existing mono record-player to stereo
Pre-amp/control unit + Z40 amp + Q16 speaker. Total Project 80 cost: £28.25 + VAT.

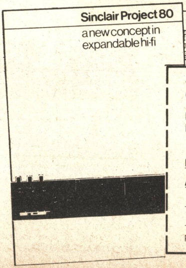
What more can we tell you?

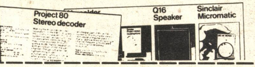
The basic facts are covered on these two pages. And you'll find Project 80 at stores like Laskys and Henry's.

But before you look, why not get really detailed information? Clip the FREEPOST coupon for the fully-illustrated Project 80 folder – today!

**Sinclair Radionics Ltd,
London Road, St Ives, Huntingdon, Cambs., PE17 4HJ.
Telephone: St Ives (0480) 64646.**

sinclair





To: Sinclair Radionics Ltd, FREEPOST, St Ives, Huntingdon, Cambs., PE17 4BR.

Please send me, by return post, a copy of the fully-illustrated Project 80 folder.

Name ______________________

Address ______________________

____

____

Please print FREEPOST – no stamp needed PE5

ERSIN
Multicore
5 CORE SOLDER

for fast easy reliable soldering
EASY TO USE DISPENSERS AND REELS
IDEAL FOR HOME CONSTRUCTORS

Ersin Multicore Solder contains 5 cores of non-corrosive flux instantly cleaning heavily oxidised surfaces No extra flux is required

SAVBIT handy solder dispenser

A coil of Ersin Multicore Savbit Solder in a dispenser 7ft 6 in of 18 s.w.g. (2.2 metres of 1.22mm). The Solder that reduces the wear of soldering iron bits.

Size 5 32p

SAVBIT solder for general purpose work

A handy plastic reel of SAVBIT alloy. 63ft of 18 s.w.g. (19.2 metres of 1.22mm)

Size 12 £1.72

ALU-SOL for soldering aluminium

New Multicore Alu-sol flux-cored solder in 16 s.w.g. No extra flux needed. Plastic reel holds 36ft. Supplied with full instructions. Also available in solder dispenser.

Size 4 £2.32

Fine gauge solder for soldering small components

Fine gauge solder for soldering small components 138ft of 22 s.w.g. (42.0 metres of 0.71mm) Ersin Multicore 5 core solder wound on a plastic reel. Suitable for intricate work and small components.

Size 10 £1.44

For soldering fine joints

Dispensers of Ersin Multicore Solder make those small jobs easier. 21ft of 22 s.w.g. (6.4 metres of 0.71mm) solder, specially suitable for soldering tine wires, small components and for repairing printed circuits.

Size 15 36p

Or size 19A for kit wiring or Radio and T.V. repairs 7ft. (2.1 metres) of 18 s.w.g. (1.22mm) Ersin Multicore Solder.

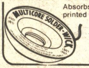
Size 19A 34p

NEW **BIB WIRE STRIPPER & CUTTER**

Fitted with unique 8 gauge selector with handle locking device and easy grip handles. Spring incorporated for automatic opening. Strips insulation from flex and cables in seconds and can also be used as a cutter.

Model 8B.80p

NEW **SOLDER WICK**



Absorbs solder instantly, from tags and printed circuits. Only needs 40 to 50 Watt soldering iron. Quick and easy to use. Does not need flux and is non-corrosive.

Size 18 90p

Bib Hi-Fi Accessories Limited,
Sole U.K. Sales Concessionaires. P.O. Box 78 Hemel Hempstead, Herts. HP2 4RH

Prices shown are recommended retail excluding V.A.T.
From Electrical and Hardware Shops. If unobtainable, send 15p P&P.
Prices and specifications subject to change without notice

---

110 OPERATIONAL AMPLIFIER-PROJECTS FOR THE HOME CONSTRUCTOR

by R. M. Marston Price **£1·90**

THE AUDIO HANDBOOK by G. J. King. Price £5·25.

COLOUR T.V. SERVICING by G. J. King. Price £4·65.

THE RADIO AMATEUR'S HANDBOOK 1975 by A.R.R.L. Price £3·50.

AN INTRODUCTION TO DIGITAL LOGIC by A. Potton. Price £3·15.

ELECTRONICS SELF-TAUGHT WITH EXPERIMENTS AND PROJECTS by J. Ashe. Price £2·05.

BASIC ELECTRONICS PROBLEMS SOLVED by D. A. Smith. Price £1·80.

WORKING WITH THE OSCILLOSCOPE by A. C. W. Saunders. Price £1·70.

TOWERS' INTERNATIONAL TRANSISTOR SELECTOR by T. D. Towers. Price £3·20.

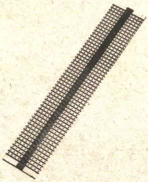
★ PRICE INCLUDES POSTAGE ★

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKIST
of British and American Technical Books
19-21 PRAED STREET
LONDON W2 1NP
Phone 01-723 4185
Closed Saturday 1 p.m.

VEROSTRIP

LENGTH 8·5"



WIDTH 1·5"

Available from your Local Retailer

0·1 and 0·15 pitch Vero Strip is suitable for all applications where Tag Boards can be used.

Vero

VERO ELECTRONICS LTD
INDUSTRIAL ESTATE
CHANDLERS FORD HANTS

CONSTRUCTIONAL KITS

In stock :
Mullard CCTV Camera, P.E. CCTV Camera, P.W. Tele-Tennis, Crofton UHF Modulator, Crofton VHF Modulator, Electronic Dice (Ready Assembled) in attractive case. P.W. Electronic Organ Kit.

Further kits will be added to the range. Kits are complete, down to the last nut, including attractively finished ready drilled, painted and silk screened panels. A FREE get-you-going technical Back-up service is available.

A P.C.B. service is available for any published design at competitive prices.

As well as holding large stocks of electronic components we are also importing a range of competitive products such as Stereo Headphones, telephone desk amplifiers, Stereo 8 track head cleaner and demagnetizers, Mini drills, etc.

Full list send 10p. stamp on large envelope. Alternatively, call in for a demonstration of any kit.

CROFTON ELECTRONICS

124 Colne Road, Twickenham
Middlesex TW2 6QS
Telephone 01-898 1569
Telex 934642 Cadanac LDN

Use Access here
BARCLAYCARD

ALL MAIL ORDER BY RETURN. C.O.D. SERVICE WELCOME

C. T. ELECTRONICS

VAT
Unless otherwise stated all prices are EXCLUSIVE of VAT. Please add 8% to all orders. Carriage: orders under £5 plus 20p. Over £5 post free.

All mail order and enquiries to 270 Acton Lane, Chiswick W4 5DG. Tel. 01-994 6275

SEMICONDUCTORS

AC107	35p
AC125	25p
AC126	25p
AC127	27p
AC128	25p
AC176	25p
AC188	30p
ACY17	25p
ACY18	30p
ACY19	30p
ACY20	25p
ACY21	30p
AD140	60p
AD142	50p
AD149	60p
AD161	44p
AD162	44p
AF114	25p
AF115	25p
AF116	25p
AF117	25p
AF118	60p
ASZ21	60p
ASY28	30p
BA102	33p
BA112	50p
BA114	16p
BA156	15p
BC107	12p
BC108	12p
BC109	14p
BC113	15p
BC115	15p
BC116	16p
BC117	20p
VC118	12p
BC147	11p
BC148	11p
BC149	12p
BC153	15p
BC157	14p
BC158	15p
BC169	15p
BC182	12p
BC183	12p
BC184	14p
BC186	25p
BC212	14p
BC212L	16p
BC213	14p
BC214	14p
BC301	25p
BC302	25p
BC303	40p
BCY30	40p
BCY31	55p
BCY32	95p
BCY34	60p
BCY38	65p
BCY39	£1·00
BCY55	£1·50
BCY70	22p
BCY71	22p
BCY72	22p
BD121	75p
BD123	75p
BD124	65p
BD131	40p
BD132	50p
BD153	75p
BD156	75p
BDY11	£1·40
BDY17	£1·60
BDY19	£1·95
BDY20	£1·40
BF152	20p
BF194	14p
BF195	15p
BF196	15p
BF197	20p
BF200	30p
BF224J	30p
BFX29	30p
BFX34	30p
BFX85	30p
BFX86	30p
BFX88	30p
BFY10	35p
BFY44	50p
BFY50	25p
BFY51	25p
BFY52	25p
BFY53	25p
BFY90	65p
BSW63	65p
BSW68	80p
BY127	20p
BY134	65p
IS100	15p
IS103	15p
MJ340	50p
MJ481	95p
MJ2801	£1·25
MJ2901	£1·95
MJE340	50p
MJE370	75p
MJE371	90p
MJE520	65p
MJE2955	£1·20
MJE3055	75p
MM1613	45p
MM1712	60p
MPF102	45p
MPF103 (2N5457)	35p
MPF104 (2N5458)	35p
MPF105 (2N5459)	40p
OA47	10p
OA70	10p
OA79	10p
OA81	10p
OA90	10p
OA91	10p
OA200	10p
OA202	10p
OA210	35p
OA211	35p
OC16	90p
OC19	85p
OC22	55p
OC26	65p
OC28	60p
OC35	60p
OC36	65p
OC42	40p
OC44	20p
OC45	25p
OC70	15p
OC71	12p
OC72	20p
OC75	25p
OC76	25p
OC77	40p
OC81	25p
OC83	25p
OC84	25p
OC139	30p
OC170	25p
OC171	30p
OC200	60p
OC201	60p
OC202	75p
TIP29A	45p
TIP30	55p
TIP31A	57p
TIP32A	69p
TIP33A	£1·00
TIP34A	£1·40
TIP35A	£3·20
TIP36A	£3·50
TIP41A	70p
TIP42A	85p
TIP29B	54p
TIP30B	60p
TIP31B	65p
TIP32B	77p
TIP33B	£1·06
TIP34B	£1·62
TIP35B	£2·71
TIP36B	£3·50
TIP41B	78p
TIP42B	95p
TIP29C	68p
TIP30C	72p
TIP31C	80p
TIP32C	£1·00
TIP33C	£1·20
TIP34C	£1·80
TIP35C	£3·00
TIP36C	£3·75
TIP41C	90p
TIP42C	£1·00
TIS50	40p
ZTX107	15p
ZTX300	15p
ZTX500	16p
ZTX501	20p
ZTX504	50p
ZTX531	30p
ZTX550	25p
IN659	8p
IN914	8p
IN916	8p
IN4001	8p
IN4002	9p
IN4003	9p
IN4004	10p
IN4005	12p
IN4006	14p
IN4007	16p
IN4148	7p
2N696	25p
2N697	20p
2N698	25p
2N706	12p
2N706A	15p
2N708	15p
2N930	20p
2N1132	25p
2N1302	16p
2N1303	16p
2N1304	25p
2N1305	25p
2N1306	25p
2N1307	25p
2N1308	25p
2N1309	25p
2N1613	25p
2N1711	25p
2N2147	70p
2N2160	65p
2N2217	25p
2N2218	25p
2N2219	25p
2N2222	20p
2N2222A	25p
2N2306	70p
2N2477	30p
2N2640	50p
2N2846	£1·50
2N2904	25p
2N2906	25p
2N2907	25p
2N2926	12p
2N3053	25p
2N3054	65p
2N3055	50p
2N3232	70p
2N3525	95p
2N3643	30p
2N3702	14p
2N3703	12p
2N3704	12p
2N3705	12p
2N3706	12p
2N3707	12p
2N3708	12p
2N3709	12p
2N3771	£1·70
2N3772	£2·00
2N3773	£2·50
2N3819	35p
2N3320	55p
2N3866	85p
2N3904	22p
2N3905	25p
2N4058	12p
2N4059	12p
2N4060	12p
2N4061	12p
2N4126	17p
2N4286	15p
2N4287	15p
2N4288	15p
2N4289	15p
2N4290	15p
2N4444	£1·90
2N4871	35p
2N4903	£1·10
2N5069	£1·10
2N5191	96p
2N5194	£1·10
40360	50p
40361	50p
40362	50p
40669	90p
40673	70p
D5151 Microwave Diode	£1·00

QTY. DISCOUNTS: 12 + 10%; 25 + 15%; 100 + 20%

S.C.R.s

CRS1/05	40p
CRS1/10	56p
CRS1/20	60p
CRS1/40	65p
CRS1/60	90p
CRS3/10	62p
CRS3/20	62p
CRS3/40	90p
CRS7/400	£1·00
CRS16/100	85p
CRS16/200	90p
CRS16/600	£1·60
C106B	45p
C106D	70p
40669	90p
TIC44	35p
2N4444	£1·90
BT10/500A	90p

BRIDGE RECTIFIERS

W02 1A 200V	38p
BY164 1·4A 200V	57p
MDA952/2 6A 100V	80p

ZENER DIODES

BZY88 Series 400mW 3·3V–33V, 5%	11p
1·5W range	25p
10W range	45p

L.E.D.

TIL209	38p
HP5082	28p
MA2082R	20p

L.D.R.

ORP12	60p

NE555 Timer	80p

TRIACS

TXL228B 8A 400V	85p
SC40D	£1·40
SC40E	£1·65
SC45D	£1·70
SC45E	£2·10
SC50D	£2·42
SC50E	£2·70
DIAC	25p

LINEAR I.C.s

LM309K 5V 1A Voltage Reg	£2·10
LM723C 2·37V 150mA Voltage Reg.	£1·05
MFC4000 250mW Audio	75p
TBA800 5 Watt Audio	£1·50
709C Op Amp D.I.L./TO99	45p
741C Op Amp 8/14 D.I.L./TO99	35p
748C Op Amp D.I.L.	75p
747C Dual OP Amp	£1·20
ZN414 Radio I.C.	£1·25
TAD100 Radio I.C. inc. Filter	£1·90
CA3014	£1·55
CA3018	£1·00
CA3028	£1·20
CA3036	£1·00
CA3046	95p
CA3048	£2·35
CA3075	£1·60
CA3090Q	£4·85
MC1303L	£2·20
MC1310P	£2·80

TO3 VOLTAGE REGULATORS
L005 5V 650mA
L036 12V 500mA
L037 15V 450mA £1·60 each

VEROBOARD

	0·1	0·15
2½ × 3¾	32p	23p
2½ × 5	35p	35p
3¾ × 3¾	35p	35p
3¾ × 5	40p	41p
17 × 2½	£1·05	79p
17 × 3¾	£1·43	£1·12
17 × 5	£1·84	—
PIN INS. TOOL	72p	72p
SP.F. CUTTER	52p	52p
100 PINS SS	30p	30p
100 PINS DS	30p	30p
500 PINS SS	£1·20	£1·20
500 PINS DS	£1·20	£1·20

ALSO STOCKED

Electrolytic Capacitors Mullard, Sprague, Lorlin etc. Polyester, Polystyrene, Silver Mica Capacitors, etc. Resistors ⅛W-10Watt.

Potentiometers: carbon, wirewound, Preset, Rectilinear multiturn. Antex Soldering Irons, switches, rotary, slide, toggle. etc. Cable, veroboard.

Potentiometers

Linear or Log	Single	Double
Rotary Pots	15p	42p
Rotary Switched	25p	—

★★SPECIAL OFFERS★★

MINIATURE MAINS TRANSFORMER. PRI 240V SEC, 12V 100MA Manuf.: Hinchley. Size: 36 × 45 × 40mm F.C. 53mm. Price 1—**65p.** 100—**60p ea.** 1,000—**50p ea.** 10,000—**40p ea.**

3 CORE PVC INSULATED MAINS CABLE, GREY ML6650, 3 × 7/0·2mm. Price 100m—**£4·50.** 1,000m—**£35.** 10,000m—**£330.**

0·47mfd. 50V MYLAR FILM CAPACITOR. Size 1in × 0·35in × 0·65in P.C. Mount. Price 100—**4p ea.** 1,000—**3p ea.**

240V A.C. SOLENOID. Reversible operation; twin coil. Size approx. 2¾in × 1½in × 1¼in **90p ea.**

30 unmarked OC71 transistors **£1·00**

25 Unmarked 250mW Zenerdiode, 4·7V, 5·1V, 6·2V, 7·5V, 9·1V, 10V. Measured and tested **£1·00**

Please state voltage required

50 GE Diode OA47 equivalent **£1·00**

TRANSFORMER: DOUGLAS PRI, 0, 115, 200, 220, 240 SEC. 25-0-25-0-6V, 2½A, **£4·50** + **50p p.p.**

TRANSFORMER
PRI, 0, 115, 160, 205, 225, 245. SEC. 35-0-35, 1·2A **£4·50** + **50p p.p.**

MULLARD TUBULAR CERAMIC UHF TRIMMERS (PROFESSIONAL)
Type 092 0·8-2·2p
801 0·8-2·2p Price **10p ea.**
991 0·5-1·3p

QUANTITY DISCOUNTS PLEASE TELEPHONE

1,000pF Feedthrough capacitor **5p ea.**

Miniature tubular P.C. trimmers
3·5-13pF
6-30pF **10p ea.**
4p c/o Varley 700Ω relay **50p ea.**

METAL BOXES

ALUMINIUM BOXES IDEAL FOR VEROBOARD WITH BASE AND P.K. screws

	Length	Width	Height	
AB7	2¾in	5¼in	1½in	55p
AB8	4in	4in	1½in	55p
AB9	4in	2¾in	1½in	55p
AB10	4in	5¼in	1½in	55p
AB11	4in	2½in	2in	65p
AB12	3in	2in	1in	50p
AB13	6in	4in	2in	77p
AB14	7in	5in	2½in	90p
AB15	8in	6in	3in	£1·16
AB16	10in	7in	3in	£1·32
AB17	10in	4½in	3in	£1·10
AB18	12in	5in	3in	£1·32
AB19	12in	8in	3in	£1·80

ALUMINIUM BOXES WITH SLOPING TOP PANEL—IDEAL FOR PRE-AMPS, ETC., USING SLIDER CONTROLS

AB20 8in Long 9in Wide 3½in High at back £2·20
2in High at front 6in Slope to front
With P.K. Screws
AB21 As above but 10in long £2·40
AB22 As above but 12in long £2·60

ELECTRONIC COMPONENTS

BARGAIN COMPONENT PACKS
ALL COMPONENTS NEW AND UNUSED

£1 plus 25p p.p. per pack, £5 for 5 packs p/free.

Pack No.
1 500 Carbon resistors, ¼, ½, 1, 2W.
2 100 Electrolytic Condensers.
3 250 Ceramic, Polystyrene, Silver Mica, etc., Condensers.
4 250 Polyester, Polycarbonate, paper, etc., Condensers.
5 25 Potentiometers, assorted.
6 250 High-stab. 1%, 2%, 5% resistors.
7 50 Assorted Tagstrips.
8 1lb. Assorted nuts, bolts, washers, spacers, etc.
9 25 Assorted switches, rotary, lever, micro, toggled, etc.
10 50 Preset Potentiometers.
11 Trial mixed component pack £1.
12 Jumbo mixed pack £5.

DIGITAL INTEGRATED CIRCUITS

SN7400	18p
SN7401	18p
SN7402	20p
SN7403	20p
SN7404	20p
SN7405	20p
SN7406	30p
SN7407	30p
SN7408	20p
SN7409	40p
SN7410	18p
SN7411	23p
SN7412	22p
SN7413	40p
SN7416	30p
SN7417	30p
SN7420	20p
SN7422	38p
SN7423	38p
SN7425	38p
SN7427	42p
SN7428	50p
SN7430	20p
SN7432	42p
SN7433	70p
SN7437	50p
SN7438	50p
SN7440	20p
SN7441AN	75p
SN7442	75p
SN7443	£1·00
SN7445	£1·70
SN7446	£2·00
SN7447	£1·50
SN7448	£1·75
SN7450	20p
SN7451	20p
SN4753	20p
SN7454	20p
SN7460	20p
SN7470	30p
SN7472	30p
SN7473	40p
SN7474	40p
SN7475	55p
SN7476	45p
SN7480	80p
SN7481	£1·25
SN7482	87p
SN7483	£1·00
SN7484	90p
SN7486	45p
SN7490	75p
SN7491AN	£1·00
SN7492	75p
SN7493	75p
SN7494	80p
SN7495	80p
SN7496	£1·00
SN7497	£2·25
SN74100	£2·00
SN74104	£1·45
SN74105	£1·00
SN74107	55p
SN74110	80p
SN74118	£1·90
SN74119	£1·90
SN74121	65p
SN74122	£1·35
SN74123	£2·00
SN74141	£1·00
SN74145	£1·50
SN74150	£1·35
SN74151	£1·10
SN74153	£1·35
SN74154	£2·00
SN74155	£1·55
SN74156	£1·55
SN74157	£1·80
SN74160	£1·60
SN74161	£1·60
SN74162	£1·60
SN74163	£3·40
SN74164	£2·75
SN74165	£2·00
SN74166	£4·00
SN74167	£4·25
SN74170	£4·10
SN74174	£2·00
SN74175	£1·35
SN74176	£1·60
SN74177	£1·60
SN74180	£1·55
SN74181	£6·00
SN74182	£2·00
SN74184	£2·45
SN74185A	£2·40
SN74190	£1·95
SN74191	£1·95
SN74192	£2·00
SN74193	£2·00
SN74194	£2·50
SN74195	£1·85
SN74196	£1·50
SN74197	£1·50
SN74198	£3·00
SN74199	£2·60

★ ★ SPECIAL OFFERS ★ ★

MULTICORE CABLE. 25-way, individually screened, 14/0076. **£1·00** per yard + VAT. Postage by weight.

IMHOF 19in RACKING CABINETS. 13½in high, 22in wide, 13in deep. Brand new. **£10·00** each + VAT. Carriage £1·00.

SIEMENS CONTACTORS. Over 1,000 in stock. All types. Phone or write for details.

METAL OXIDE RESISTORS TR4/5/6 in stock. All Values. 1-off price **3p** each. Discount on quantity.

10 TURN TRIMPOTS by Bourns, Mec, Painton, etc. All values in stock. **50p** each. Discount on quantity.

9-WAY FULLY STABILISED BATTERY CHARGERS. 24in L, 7½in H, 7in D. Price **£14·00** each. Carriage £1·00 + VAT.

DEAC RECHARGEABLE BATTERY CASSETTES. 13·4V (nom.). Type B/SA 80351/108. Heavy duty encapsulated DEAC supply. Size 3½in × 2½in × 1½in. Price **£5·00** + VAT.

8-WAY BATTERY CHARGER. Type CC 999. Charges up to 8 of the above battery cassettes. Price **£14·00** + VAT.

12-WAY BATTERY CHARGER. Type CC 999. Charges up to 12 of 13·4V DEAC batteries. Metered battery condition check. Price **£25·00** + VAT.

We are open from 9.30 a.m.—6.00 p.m. Monday–Saturday

We have the largest retail selection of components available. Phone or write if you are in difficulties obtaining a particular component.

C.O.D. service welcome. All mail order by return. Official orders welcome by Government establishments, Education authorities, etc.
Tel. 01-994 6275

A TECHNOLOGICAL MIRACLE DEVELOPED BY U.S. SPACE SCIENTISTS!
NOW YOU CAN JUDGE FOR YOURSELF WHETHER OR NOT THIS
MAKES VIRTUALLY EVERY OTHER TYPE OF WATCH IN THE WORLD OBSOLETE!
THE GREATEST HOROLOGICAL ADVANCE SINCE THE INVENTION OF THE CHRONOMETER
THE SYSTEM EXCELLED IN ACCURACY ONLY BY THE ATOMIC FREQUENCY STANDARD!
SANDS
12:35
LIQUID CRYSTAL QUARTZ
WRIST WATCH
WITH CONTINUOUS 'COMPUTER DIGITAL READ OUT'
The space-age system FEATURED ON TV!
SAVE UP TO £140!
ELSEWHERE YOU COULD PAY UP TO £200 OR MORE FOR THIS INCREDIBLE NEW SPACE-AGE TYPE OF WATCH!
OUR WORLD SHATTERING PRICE ONLY
£57·95
REGISTERED POST PACK ETC. 50p

FROM WORLD FAMOUS MAKERS! The greatest Watch offer since time began! Everyone who sees it is **fascinated** by it! It's unbelievable! Continuous digital reading—hours and minutes **AND** second Pulsator miraculously transmits before your very eyes like a continuously changing TV Picture! A new "dimension" in time! Now **YOU** can join the elite few—the proud owners of a watch that is utterly different from any other timepiece you've ever known! THEY'RE NEWS! **THE WATCH OF TOMORROW-TODAY! AND** you buy at a price that's just a fraction of what you could have paid! **But remember**—you can **only** buy at this amazing price from Shopertunities. ★ **UNBELIEVABLY ACCURATE TO WITHIN SECONDS A YEAR! The system excelled in accuracy only by the Atomic frequency standard! Now TIM** can phone **you** for a time check! ★ NO MOVING PARTS! ★ NO MAINTENANCE! ★ ABSOLUTELY SILENT! ★ BUILT TO GIVE A LIFE-TIME OF SERVICE! ★ **18CT** GOLD PLATED CASE! ★ BRAND SPANKING NEW ADVANCE 1975 MODEL! WRITTEN GUARANTEE. Developed from the fantastic "space-age" techniques that first put men on the moon, this incredible watch is based on the natural action of Quartz Crystal, that vibrates approx. 32,768 times per second! A veritable miracle of micro-circuitry! An "electronic brain" with 1500 Transistors! You could even spend £400 or more for a Quartz Crystal watch! OUR fantastic cash price for **this** masterpiece is **ONLY £57·95, registered post, pack, etc. 50p, including expensive matching adjustable safety bracelet and presentation casket.** Send quickly and test for yourself on 7 days' mail order approval from receipt of goods. **REFUND IF NOT DELIGHTED. Or send only £12·50 deposit, balance by 6 monthly payments of £9·47** (total credit price **£69·32** plus post). Please hurry! Limited quantity! **THIS** is the greatest investment you'll **EVER** make! Or call at either store and see this fabulous watch for yourself! At this price **you** just **can't** lose!

Order by post to Uxbridge Road, or call at either store
Callers: ACCESS & BARCLAY CARDS ACCEPTED
Bargains galore at both stores—
COMMERCIAL TRAVELLERS NOTE: Merchandising office at Holborn.

SEND OR CALL **SHOPERTUNITIES LTD**

Dept. PE/42, 164 UXBRIDGE ROAD (facing Shepherds Bush Green), LONDON W12 8AQ. (Thurs. 1, Fri. 7). Also at 37/39 HIGH HOLBORN (opposite Chancery Lane), LONDON, W.C.1. (Thurs. 7 p.m.) BOTH OPEN MON. TO SAT. 9 A.M. TILL 6 P.M.

12in LONG PERSISTENCE CRT. Full spec. Price **£6·50** to include V.A.T. and Carriage.

MAKE YOUR SINGLE BEAM SCOPE INTO A DOUBLE WITH OUR NEW LOW PRICED SOLID STATE SWITCH. 2Hz to 8MHz. Hook up to a 9 volt battery and connect to your scope and have two traces for ONLY **£6·25**, P. & P. 25p. (Not cased. not calibrated.)

WIDE RANGE WOBBULATOR. 5MHz to 150MHz up to 15MHz sweep width. Only 3 controls. preset RF level. sweep width and frequency. Ideal for 10·7 or TV IF alignment. filters. receivers. Can be used with any general purpose scope. Full instructions supplied. Connect 6·3V a.c. and use within minutes of receiving. All this for ONLY **£6·75**, P. & P. 35p. (Not cased. not calibrated.)

20Hz to 200kHz WB, SINE and SQUARE GENERATOR. Four ranges. Independent amplitude controls. thermistor stabilised. Ready to use. 9V supply required. **£8·85** each. P. & P. 35p. (Not cased. not calibrated.)

GRATICULES 12cm x 14cm high quality plastic **15p** each. P. & P. 8p.

Large quantity of good quality components—**NO PASSING TRADE**—so we offer 3lb of **ELECTRONIC GOODIES** for **£1·70.** Post paid.

ROTARY SWITCH PACK—6 brand new switches (1 ceramic; 1 off 4 pole. 2 way. etc.). **50p**, P. & P. 37p

P.C.B. PACKS. S & D. Quantity 2 sq. ft—no tiny pieces **50p**, P. & P. 37p

CAPACITOR PACK—50 brand new components. only **50p**, P. & P. 37p.

TRIMMER PACK. 2 twin 50/200pF ceramic, 2 twin 10/60pF ceramic; 2 min strip with 4 preset 5/20pF on each; 3 air spaced preset 30/100pF on ceramic base. ALL BRAND NEW. **25p** the lot, P. & P. 15p.

PHOTOCELL equ. OCP71, **13p** each. **MULLARD** OCP70, **10p** each.

DELIVERED TO YOUR DOOR, 1cwt of Electronic Scrap chassis, boards, etc. No rubbish. FOR ONLY **£4.**

MODERN TELEPHONES. Type 706: two-tone grey or black, **£3·75** each. Type 7006: two-tone grey or green, **£3·75** each. Style similar to Type 746: grey, green or black, **£3** each. P. & P. all types 45p each.

Ideal **EXTENSION TELEPHONES** with standard GPO type dial, bell and lead coding, **£1·75** each, P. & P. 45p.

HANDSETS. Complete with 2 inserts and lead, **75p** each, P. & P. 37p.

DIALS. ONLY **75p** each, P. & P. 25p.

HIGH VALUE—PRINTED BOARD PACK. Hundreds of components, transistors, etc.—No 2 boards the same. No short leaded transistor computer boards. **£1·75,** post paid.

BEEHIVE TRIMMER 3/30 pF. Brand new. Qty 1–9 **13p** each, P. & P. 15p; 10–99 **10p** each, P. & P. 25p; 100–999 **7p** each, P. & P. free.

HE CRYSTAL DRIVE UNIT. 19in rack mount. Standard 240V input with superb crystal oven by Labgear (no crystals) **£5** each. Carr. £2.

1,000pF FEED THRU CAPACITORS. Only sold in packs of 10, **30p,** P. & P. 15p.

ALWAYS SOME CHEAP SCOPES AVAILABLE—or build your own. Send for our tube list with a S.A.E.

PLEASE ADD V.A.T. AT 8%
OPEN 9 a.m. to 6.30 p.m. ANY DAY

Use Access here

CHILTMEAD LTD
7/9 ARTHUR ROAD, READING, BERKS.
(rear Tech. College)   Tel. Reading 582605/65916

BARCLAYCARD welcome here

VEROBOARD
Approx. 8 pieces, total 100sq.in. assorted sizes and pitches **£1·15.**

CAPACITORS
200 Mica, ceramic, poly, etc. **£1,** 15,000 **£42.** 15 diff. trimmers, air-spaced and compression up to 1250pF. Only **£1.**

8 PIN DIL 741's

FULL SPEC. OF COURSE
10+ **26p;** 25+ **23p;** 100+ **21p;** 250+ **20p.**

PC ETCHING KIT
Contains 1lb ferric chloride, 100sq.in. copper clad board, DALO etch resist pen, abrasive cleaner, etching dish and instructions **£3·30.**

FERRIC CHLORIDE
Anhydrous to Mil-spec in 1lb double sealed packs. 1lb **90p;** 3lb **£1·80;** 10lb, **£4·65.**

COMPUTER PANELS
Large quantity always available. 3lb assorted **£1·60;** 7lb **£2·85;** 56lb **£15.**

12 high quality panels with IC's, trimpots, power transistors, etc. **£2·65.**

Pack with 50 14 pin DIL DTL IC's **£1·20.** Pack with 20 multi-turn trimpots plus other parts **£1·10.** Pack with 5 1A 200V SCR's plus 60 other parts **60p.**

7lb BARGAIN PARCELS
Hundreds of new components—resistors, capacitors, pots, switches plus PC boards with transistors and diodes, also loads of odds and ends. Contents always changing as new stocks arrive, **£2·60.**

TRANSFORMERS
All mains primary. 6–0–6V at 100mA **85p;** 9–0–9 Vat 100mA **90p;** 12–0–12V at 100mA **95p;** 24–0–24V at 500mA **£2.** Ex-equip: 22½–0–22½V at 1A **£2·10;** 18V at 5A **£3·40;** 55V at 5A **£4·50.**

HEAT SINKS
6 × 5 × 3in. finned aluminium with 2 × OC29 or 2 × OC35. Only **£1·20.**

POWER SUPPLIES
G101: Mains transformer, 2A thermal cut-out, bridge rect. Will give 1·7V–10·5V output with 2 extra capacitors (provided). With data **£1·30.**

7 SEGMENT LEDS
14 PIN DIL PACKAGE
19 × 11 mm
4 for **£3·60**
6 for **£5·20**

MICROPHONES
V996 dynamic microphone, 50k impedance, on/off switch, heavy desk stand. Very smart appearance **£3·30.** Crystal microphone insert 1in. dia. **35p.**

555 TIMERS

3–9 **60p;** 10–24 **50p;** 25–99 **46p;** 100+ **43p.**

Price increases, which we regret, are due to higher postal, packaging and advertising costs. Prices include 8% VAT and inland postage. S.A.E. list. Computers, components and equipment always wanted for cash.

GREENWELD ELECTRONICS (PE5)

Mail order dept., retail/wholesale shop
51 SHIRLEY PARK ROAD, SOUTHAMPTON SO1 4FX. Tel. (0703) 772501

Also callers welcome at 21 Deptford Broadway, SE8. Tel. 01-692 2009, and 38 Lower Addiscombe Road, Croydon. Tel. 01-688 2950.

Marshall's

A. Marshall (London) Ltd. Dept. PE
42 Cricklewood Broadway London NW2 3DH Telephone 01-452 0161 2 Telex 21492
& 85 West Regent Street Glasgow G2 2QD Telephone 041-332 4133

Everything you need is in our New 1975 Catalogue
available now price 25p
(100 pages of prices and data)

Call in and see us 9–5.30 Mon–Fri
9–5.00 Sat
Trade and export enquiries welcome

Top 500 Semiconductors From the Largest Range in the U.K.

2N456	0·80
2N456A	0·85
2N457A	1·20
2N490	4·14
2N491	4·38
2N492	5·00
2N493	5·20
2N696	0·22
2N697	0·16
2N698	0·82
2N699	0·59
2N706	0·14
2N706A	0·16
2N708	0·17
2N709	0·42
2N711	0·50
2N718	0·23
2N718A	0·28
2N720	0·57
2N914	0·39
2N916	0·28
2N918	0·32
2N929	0·37
2N930	0·22
2N1302	0·19
2N1303	0·19
2N1304	0·26
2N1305	0·24
2N1306	0·31
2N1307	0·30
2N1308	0·47
2N1309	0·47
2N1671	1·54
2N1671A	1·67
2N1671B	1·85
2N1711	0·45
2N1907	5·50
2N2102	0·64
2N2147	0·78
2N2148	0·94
2N2160	0·90
2N2218A	0·22
2N2219	0·24
2N2219A	0·26
2N2220	0·25
2N2221	0·18
2N2221A	0·21
2N2222	0·20
2N2222A	0·25
2N2368	0·25
2N2369	0·20
2N2369	0·20
2N2646	0·55
2N2647	0·98
2N2904	0·22
2N2904A	0·24
2N2905	0·25
2N2905A	0·26
2N2906	0·19
2N2906A	0·21
2N2907	0·22
2N2907A	0·24
2N2924	0·20
2N2925	0·20
2N2926	
Green	0·12
Yellow	0·12

Orange	0·12
2N3053	0·25
2N3054	0·60
2N3055	0·75
2N3390	0·45
2N3391	0·28
2N3391A	0·29
2N3392	0·15
2N3393	0·15
2N3394	0·15
2N3402	0·18
2N3403	0·19
2N3440	0·59
2N3441	0·97
2N3442	1·40
2N3414	0·20
2N3415	0·21
2N3416	0·34
2N3417	0·24
2N3638	0·15
2N3638A	0·15
2N3639	0·27
2N3641	0·17
2N3702	0·12
2N3703	0·13
2N3704	0·15
2N3705	0·15
2N3706	0·15
2N3707	0·18
2N3708	0·14
2N3709	0·15
2N3710	0·15
2N3711	0·15
2N3712	1·20
2N3713	1·20
2N3714	1·38
2N3715	1·50
2N3716	1·80
2N3771	2·20
2N3772	1·80
2N3773	2·65
2N3789	2·06
2N3790	2·40
2N3791	2·35
2N3792	2·60
2N3794	0·24
2N3819	0·37
2N3820	0·64
2N3823	0·78
2N3904	0·27
2N3906	0·27
2N4036	0·67
2N4037	0·42
2N4058	0·18
2N4059	0·15
2N4060	0·15
2N4061	0·15
2N4062	0·15
2N4126	0·21
2N4289	0·34
2N4919	0·95
2N4920	1·10
2N4921	1·83
2N4922	1·00
2N4923	1·00
2N5190	0·92
2N5191	0·96

2N5192	1·24
2N5195	1·46
2N5245	0·47
2N5294	0·48
2N5295	0·48
2N5296	0·48
2N5298	0·50
2N5457	0·49
2N5458	0·46
2N5459	0·49
2N5492	0·58
2N5494	0·58
2N5496	0·61
2N5777	0·45
2N6027	0·45
3N128	0·73
3N139	1·42
3N140	1·00
3N141	0·81
3N200	2·49
40361	0·40
40362	0·45
40363	0·88
40389	0·46
40394	0·56
40395	0·65
40406	0·44
40407	0·35
40408	0·50
40409	0·52
40410	0·52
40411	2·00
40594	0·74
40595	0·84
40601	0·67
40602	0·61
40603	0·58
40604	0·56
40636	1·10
40669	1·00
40673	0·73
AC126	0·20
AC127	0·20
AC128	0·20
AC151V	0·27
AC152V	0·49
AC153	0·35
AC153K	0·40
AC154	0·25
AC176	0·30
AC176K	0·40
AC187K	0·35
AC188K	0·40
ACY18	0·24
ACY19	0·27
ACY20	0·22
ACY21	0·26
ACY28	0·20
ACY30	0·58
AD142	0·57
AD143	0·68
AD149V	1·20
AD150	1·15
AD161	0·50
AD162	0·50
AD161 }	PR
AD162 }	1·15

AF106	0·40
AF109R	0·40
AF114	0·35
AF115	0·35
AF116	0·35
AF117	0·35
AF118	0·35
AF124	0·30
AF125	0·30
AF126	0·28
AF127	0·28
AF139	0·65
AF186	0·46
AF200	0·65
AF239	0·65
AF240	0·90
AF279	0·70
AF280	0·79
AL102	1·00
AL103	1·00
BC107	0·14
BC108	0·14
BC109	0·14
BC113	0·15
BC115	0·17
BC116	0·17
BC116A	0·18
BC117	0·21
BC118	0·14
BC119	0·29
BC121	0·35
BC125	0·16
BC126	0·23
BC132	0·30
BC134	0·13
BC135	0·13
BC136	0·17
BC137	0·17
BC138	0·24
BC140	0·68
BC141	0·68
BC142	0·23
BC143	0·25
BC145	0·21
BC147	0·14
BC148	0·14
BC149	0·15
BC153	0·18
BC154	0·18
BC157	0·16
BC158	0·16
BC160	0·60
BC167B	0·15
BC168B	0·15
BC168C	0·15
BC169B	0·15
BC169C	0·15
BC170A	0·15
BC171	0·16
BC172	0·17
BC177	0·28
BC178	0·27
BC179	0·30
BC182	0·12
BY182L	0·12
BC183	0·12
BC183L	0·12

BC184	0·13
BC184L	0·13
BC186	0·25
BC187	0·27
BC207	0·12
BC208	0·11
BC212K	0·16
BC212L	0·16
BC214L	0·18
BC237	0·16
BC238	0·15
BC239	0·15
BC251	0·25
BC253	0·25
BC257	0·16
BC258	0·16
BC259	0·17
BC261	0·25
BC262	0·25
BC263	0·25
BC300	0·38
BC301	0·34
BC302	0·29
BC303	0·54
BC307	0·17
BC308A	0·15
BC309C	0·20
BC237	3·27
BC238	3·28
BC337	0·20
BC338	0·20
BCY30	0·80
BCY31	0·85
BCY32	1·15
BCY33	0·85
BCY34	0·79
BCY38	1·00
BCY39	1·50
BCY40	0·47
BCY42	0·28
BCY58	0·30
BCY59	0·32
BCY70	0·17
BCY71	0·22
BCY72	0·15
BD115	0·75
BD116	0·75
BD121	1·00
BD123	0·82
BD124	0·67
BD131	0·40
BD132	0·50
BD135	0·43
BD136	0·49
BD137	0·55
BD138	0·63
BD139	0·71
BD140	0·87
BD529	0·80
BD530	0·80
BDY20	1·05
BF115	0·36
BF117	0·55
BF121	0·35
BF123	0·35
BF125	0·35
BF152	0·20

BF153	0·25
BF154	0·20
BF159	0·27
BF160	0·23
BF163	0·32
BF166	0·40
BF167	0·25
BF173	0·27
BF177	0·29
BF178	0·35
BF179	0·43
BF180	0·35
BF181	0·36
BF182	0·35
BF183	0·55
BF184	0·30
BF185	0·30
BF194	0·12
BF195	0·12
BF196	0·13
BF197	0·15
BF198	0·18
BF200	0·40
BF225J	0·23
BF244	0·21
BF245	0·45
BF246	0·58
BF247	0·65
BF254	0·19
BF255	0·19
BF257	0·47
BF258	0·53
BF259	0·55
BFR39	0·24
BFR79	0·24
BFS21A	2·30
BFS28	0·92
BFS61	0·27
BFS98	0·25
BFX29	0·30
BFX30	0·27
BFX84	0·24
BFX85	0·30
BFX87	0·28
BFX88	0·25
BFX89	0·90
BFY50	0·23
BFY51	0·23
BFY52	0·21
BFY53	0·18
BFY90	0·75
BRY39	0·23
BSX20	0·21
BSX21	0·29
BU104	2·00
BU105	2·25
C106D	0·65
CA3018A	0·85
CA3020A	1·80
CA3028A	0·79
CA3035	1·36
CA3046	0·70
CA3048	2·11
CA3052	1·62
CA3089E	1·96
CA3090Q	4·23
LM301A	0·48

LM308	2·50
LM309K	1·88
LM5TI	1·50
LM380	1·10
LM381	2·20
LM702C	0·75
LM709	
TO99	0·48
8DIL	0·38
14DIL	0·40
LM710	0·47
LM723C	0·90
LM741	
TO99	0·40
8DIL	0·40
14DIL	0·38
LM747	1·00
LM748	
8DIL	0·60
14DIL	0·73
LM3900	0·70
LM7805	2·00
LM7812	2·50
LM7815	2·50
LM7824	2·50
MC1303	1·50
MC1310	2·92
MC1330P	0·90
MC1351P	0·80
MC1352P	0·80
MC1466	3·50
MC1469	2·75
ME0402	0·20
ME0404	0·13
ME0412	0·18
ME4102	0·11
ME4104	0·11
MJ480	0·95
MJ481	1·20
MJ490	1·05
MJ491	1·45
MJ2955	1·00
MJE340	0·48
MJE2955	1·20
MJE3055	0·75
MJE370	0·65
MJE371	0·75
MJE520	0·60
MJE521	0·70
MP8111	0·32
MP8112	0·40
MP8113	0·47
MPF102	0·39
MPSA05	0·25
MPSA06	0·31
MPSA12	0·35
MPSA55	0·26
MPSA56	0·31
MPSU05	0·65
MPSU06	0·58
MPSU55	0·63
MPSU56	0·80
NE555V	0·70
NE556	1·30
NE560	4·48
NE561	4·80
NE565A	4·48
OC23	1·35
OC28	0·76

OC35	0·60
OC42	0·50
OC45	0·32
OC71	0·20
OC72	0·25
OC81	0·25
OC83	0·24
ORP12	0·55
R53	1·80
SL414A	1·80
SL610C	1·70
SL611C	1·70
SL612C	1·70
SL620C	2·60
SL621C	2·60
SL623	4·59
SL640C	3·10
SL641C	3·10
SN76003N	2·92
SN76013N	1·95
SN76023N	1·60
SN76033N	2·92
ST2	0·20
TAA263	1·10
TAA300	1·80
TAA350	2·10
TAA550	0·60
TAA611C	2·18
TAA621	2·03
TAA661B	1·32
TBA641B	2·25
TBA651	1·69
TBA800	1·50
TBA810	1·50
TBA820	1·15
TBA920	4·00
TIL209	0·30
TIP29A	0·49
TIP29C	0·80
TIP30A	0·58
TIP30C	0·85
TIP31A	0·62
TIP31C	1·00
TIP32A	0·74
TIP32C	1·25
TIP33A	1·01
TIP33C	1·45
TIP34A	1·51
TIP34C	2·60
TIP35A	2·90
TIP36A	3·70
TIP41A	0·79
TIP41C	1·40
TIP42A	0·90
TIP42C	1·60
TIP49C	0·70
TIP53	0·53
TIP2955	0·98
TIP3055	0·50
TIS43	0·28
ZTX300	0·13
ZTX301	0·13
ZTX302	0·20
ZTX500	0·15
ZTX501	0·13
ZTX502	0·18
ZTX530	0·23

10% Discount to Saturday callers

Bring this advertisement with you to our shops on a Saturday and you will get a 10% discount on our goods.
This offer does not apply to kits.

P.C. Marker Pen Dalo 33PC **0·87p.**
Zeners 400MW, **11p**; 1W, **17p.**
IC Sockets 8 DIL **16p**; 14 DIL **17p**; 16 DIL **20p.**
Resistors ¼W **2p**; ½W **3p**; 2½W **9p**; 5W **10p**; 10W **12p.**

Scorpio Car Ignition Kit—£11·50 + VAT.
1 IMF440V **£1·10.**
BSTBO246 **£1·05.** Transformer **£3.**

OPTO and LEDs
Red, green and yellow.
0·16 diameter **31p**; 0·20 diameter **33p.**
DL707 **£2·35** or 4 for **£8.**
Minitron **£1·55.**

Cmos Circuits

CD4000	0·36
CD4001	0·36
CD4002	0·36
CD4006	1·58
CD4007	0·36
CD4008	1·63
CD4009	1·18
CD4010	1·18
CD4011	0·36
CD4012	0·36
CD4013	0·66
CD4014	1·72
CD4015	1·72
CD4016	0·66
CD4017	1·72
CD4018	2·55
CD4019	0·86
CD4020	1·91
CD4021	1·72
CD4022	1·66
CD4023	0·36
CD4024	1·24
CD4025	0·32
CD4027	0·43
CD4028	1·50
CD4029	3·50
CD4030	0·87
CD4031	5·19
CD4037	1·93
CD4041	1·86
CD4042	1·38
CD4043	1·80
CD4044	1·80
CD4045	2·65
CD4046	2·84
CD4047	1·65
CD4049	0·81
CD4050	0·66

Veroboard

	Copper		Plain	
	0·1	0·15	0·1	0·15
2·5 × 3¾in	36p	26p	—	17p
2·5 × 5in	40p	39p	—	19p
3¾ × 3¾in	40p	39p	—	—
3¾ × 5in	45p	47p	—	32p
3¾ × 17in	£1·61	£1·26	£1·00	£1·92
PINS × 36	30p	30p		
× 200	£1·16	£1·16		

Trade and Retail Supplied

TTL Integrated Circuits—Quality and Prices You Can't Beat

SN7400	0·16
SN7401	0·16
SN7401AN	0·38
SN7402	0·16
SN7403	0·16
SN7404	0·19
SN7405	0·19
SN7406	0·45
SN7407	0·45
SN7408	0·19
SN7409	0·22
SN7410	0·16
SN7411	0·25
SN7412	0·28
SN7413	0·35
SN7416	0·35
SN7417	0·35
SN7420	0·16
SN7423	0·29
SN7425	0·29
SN7427	0·29
SN7430	0·16
SN7432	0·28
SN7437	0·37
SN7438	0·35
SN7440	0·16
SN7441AN	0·85
SN7442	0·65
SN7445	0·90
SN7446	0·95
SN7447	0·95
SN7448	0·90
SN7450	0·16
SN7451	0·16
SN7453	0·16
SN7454	0·16
SN7460	0·16
SN7470	0·33
SN7472	0·26
SN7473	0·36
SN7474	0·36
SN7475	0·50
SN7476	0·35
SN7480	0·50
SN7481	1·25
SN7482	0·75
SN7483	0·95
SN7484	0·95
SN7485	1·25
SN7486	0·32
SN7490	0·45
SN7491	0·85
SN7492	0·45
SN7493	0·45
SN7494	0·82
SN7495	0·72
SN7496	0·75
SN74100	1·25
SN74107	0·36
SN74118	1·00
SN74119	1·92
SN74121	0·37
SN74122	0·50
SN74123	0·60
SN74141	0·85
SN74145	0·90
SN74150	1·50
SN74151	0·85
SN74153	0·85
SN74154	1·50
SN74155	1·50
SN74157	0·95
SN74160	1·10
SN74161	1·10
SN74162	1·10
SN74163	1·10
SN74164	2·01
SN74165	2·01
SN74167	4·10
SN74174	1·25
SN74175	0·90
SN74176	1·44
SN74180	1·40
SN74181	1·95
SN74190	2·30
SN74191	2·30
SN74192	1·15
SN74193	1·15
SN74196	1·60
SN74197	1·58
SN74198	2·25
SN74199	2·25

Potentiometers

Linear or Log	Single	Double
Rotary Pots	20p	45p
Rotary Switched	30p	—
Sliders	45p	75p

Full range of capacitors stocked. See catalogue for details

Presets—Horizontal or Vertical
0·1W **8p** 0·3W **10p**

Diodes and Rectifiers—A Selection from our range

IN34A	0·10
IN914	0·07
IN916	0·07
IN1183	0·84
IN1184	0·92
IN1186	1·18
IN1190	2·52
IN1191	0·59
IN1192	0·80
IN1194	1·06
IN1196	1·64
IN1198	2·40
IN1199	0·47
IN1200	0·55
IN1202	0·67
IN1204	0·97
IN1206	1·37
IN4001	0·06
IN4002	0·65
IN4004	0·07
IN4006	0·09
IN4007	0·10
IN4148	0·07
IN5054	0·18
IN5400	0·17
IN5401	0·17
IN5402	0·20
IN5404	0·22
IN5406	0·25
IN5408	0·30
IN1544	0·06
IN15132	0·25
IN15134	0·25
IN15920	0·07
IN15921	0·08
IN15922	0·08
AA116	0·08
AA118	0·08
AA119	0·08
AA129	0·15
BA102	0·25
BA115	0·10
BA142	0·17
BA144	0·12
BA145	0·18
BA148	0·20
BA154	0·12
BA155	0·12
BA156	0·15
BAX13	0·08
BAX16	0·10
BB103	0·25
BB104	0·45
BY100	0·27
BY126	0·12
BY127	0·15
BY182	1·00
BYZ10	0·60
BYZ11	0·51
BYZ12	0·51
BYZ13	0·40
OA9	0·27
OA10	0·45
OA47	0·06
OA70	0·07
OA73	0·10
OA81	0·18
OA85	0·18
OA90	0·06
OA91	0·06
OA95	0·07

Bridges and SCRs

Plastic	1A	2A	4A	6A
50	0·24	0·32	0·60	0·62
100	0·36	0·37	0·70	0·75
200	0·30	0·41	0·75	0·80
400	0·36	0·45	0·85	1·10
600	0·40	0·52	0·95	1·25

SCRs	100V	200V	400V	600V
½A TO18	0·43	0·44	—	—
1·2A plastic	0·45	0·50	0·69	0·85
3A plastic	0·55	0·63	0·70	1·05
4A plastic	0·50	0·55	0·65	—

Construction Kits

AV7 Aerial Amps	£2·04
UHS70 Transmitter	£2·79
MUE7 Receiver for above	£3·22
EW18 Electronics dice	£6·53
EX20 Electronic Dice + Sensor	£7·79

Mail Order

VAT All prices exclusive P. & P. 25p

TRY OUR NEW GLASGOW SHOP

The largest selection

EX-COMPUTER STABILISED POWER MODULES

Complete with circuit diagrams, etc.
99p each plus 22p P. & P.

LOW COST CAPACITORS

0·01μF 400V.	**3p each**
500μF 50V. Elect.	**10p each**

FIBRE-GLASS PRINTED CIRCUIT BOARDS

16¼ × 4″ approx. 2 for **55p**

DECON-DALO 33PC Marker

Etch resistant printed circuit marker pen **99p** each

VEROBOARDS

Packs containing approx., 50sq. in. various sizes, all 0·1 matric **55p**

REPANCO CHOKES & COILS

RF Chokes
CH1. 2·5mH **29p** CH2. 5·0mH **30p**
CH3. 7·5mH **31p** CH4. 10mH **33p**
CH5. 1·5mH **28p**
COILS
DRX1 Crystal set **31p** DRR2 Dual range **45p**

COIL FORMERS & CORES

NORMAN ¼″ Cores & Formers **8p**
⅜″ Cores & Formers **10p**

SWITCHES

DP/DT Toggle **36p** SP/ST Toggle **30p**

FUSES

1¼″ and 20mm. 100mA, 200mA, 250mA, 500mA, 1A, 1·5A, 2A
QUICK-BLOW **5p** each.

EARPHONES

Crystal 2·5mm plug **42p**
Crystal 3·5mm plug **42p**
8 ohms 2·5mm plug **22p**
8 ohms 3·5mm plug **22p**

DYNAMIC MICROPHONES

B1223. 200 ohms plus on/off switch and 2·5mm and 3·5mm plugs **£1·85**

3-WAY STEREO HEADPHONE JUNCTION BOX

H1012 **£1·87**

2-WAY CROSSOVER NETWORK

K4007. 80 ohms Imp. Insertion loss 3bB **£1·21**

CAR STEREO SPEAKERS

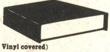
(Angled) **£3·85** per pair.

BI-PAK

CATALOGUE AND LISTS

Send S.A.E. and 10p.

INSTRUMENT CASES



(Black Vinyl covered)

No.	Length		Width		Height	Price
BV1	8″	×	5½″	×	2″	**£1·35**
BV2	11″	×	6″	×	3″	**£1·75**

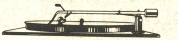
ALUMINIUM BOXES

BA1	5¼″	×	2¾″	×	1½″	**49p**
BA2	4″	×	4″	×	1½″	**49p**
BA3	4″	×	2¾″	×	1½″	**49p**
BA4	5¼″	×	4″	×	1½″	**58p**
BA5	4″	×	2½″	×	2″	**49p**
BA6	3″	×	2″	×	1″	**42p**
BA7	7″	×	5″	×	2½″	**85p**
BA8	8″	×	6″	×	3″	**£1·10**
BA9	6″	×	4″	×	2″	**70p**

P. & P. 15p on each box

BIB HI-FI ACCESSORIES

De Luxe Groov-Kleen
Model 42 £1·95
Chrome Finish
Model 60 £1·50



Ref. 36A. Record/Stylus Cleaning Kit **33p**
Ref. 43. Record Care Kit **£2·42**
Ref. 31. Cassette Head Cleaner **58p**
Ref. 32. Tape editing Kit **£1·68**
Model 9. Wire Stripper/Cutter **83p**
Ref. 46. Spirit Level **62p**

Ref. B. Stylus and Turntable Cleaning Kit **34p**
Ref. P. Hi-Fi Cleaner **31p**
Ref. 32A. Stylus Balance **£1·37**
Ref. J. Tape Head Cleaning Kit **62p**
Ref. 56. Hi-Fi Stereo Hints and Tips **42p**
Ref. 45. Auto Changer Groove Cleaner **£1·08**

ANTEX SOLDERING IRONS

X25. 25 watt **£2·05**
CCN 240. 15 watt **£2·48**
Model G. 18 watt **£2·26**
SK2. Soldering Kit **£3·25**
STANDS: ST3, suitable for all models **£1**
SOLDER: 18SWG Multicore 7oz **£1·61**
22SWG 7oz **£1·61**, 18SWG 22ft **51p**
22SWG Tube **33p**

ANTEX BITS and ELEMENTS

Bits No.		
102	For model CN240 3/32″	**42p**
104	For model CN240 3/16″	**42p**
1100	For model CCN240 3/32″	**42p**
1101	For model CCN240 ⅛″	**42p**
1102	For model CCN240 ¼″	**42p**
1020	For model G240 3/32″	**42p**
1021	For model G240 ⅛″	**42p**
1022	For model G240 3/16″	**42p**
50	For model X25 3/32″	**48p**
51	For model X25 ⅛″	**48p**
52	For model X25 3/16″	**48p**

ELEMENTS
ECN 240 **£1·30** ECCN 240 **£1·32**
EG 240 **£1·07** EX 25 **£1·16**

ANTEX HEAT SINKS 10p

VAT included in all prices. Please add 10p P. & P. (U.K. only). Overseas orders—please add extra for postage.

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C1	200	Resistors mixed values approx. count by weight	0·54
C2	150	Capacitors mixed values approx. count by weight	0·54
C3	50	Precision Resistors mixed values	0·54
C4	75	⅛th W Resistors mixed preferred values	0·54
C5	5	Pieces assorted Ferrite Rods	0·54
C6	2	Tuning Gangs, MW/LW VHF	0·54
C7	1	Pack Wire 50 metres assorted colours	0·54
C8	10	Reed Switches	0·54
C9	3	Micro Switches	0·54
C10	15	Assorted Pots & Pre-Sets	0·54
C11	5	Jack Sockets 3 × 3·5m 2 × Standard Switch Type	0·54
C12	30	Paper Condensers preferred types mixed values	0·54
C13	20	Electrolytics Trans. types	0·54
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets, etc.	0·54
C15	5	Mains Slide Switches	0·54
C16	20	Assorted Tag Strips & Panels	0·54
C17	10	Assorted Control Knobs	0·54
C18	4	Rotary Wave Change Switches	0·54
C19	2	Relays 6—24V Operating	0·54
C20	1	Pack Sheets of Copper Laminate approx. 20 sq. ins.	0·54

VISIT OUR COMPONENT SHOP

18 BALDOCK ST., WARE, Herts. (A10)
Open Mon.–Sat. 9–5.30 p.m. Tel. 61593

PLUGS AND SOCKETS

PLUGS		
PS 1	D.I.N. 2 Pin (Speaker)	0·11
PS 2	D.I.N. 3 Pin	0·12
PS 3	D.I.N. 4 Pin	0·15
PS 4	D.I.N. 5 Pin 180°	0·16
PS 5	D.I.N. 5 Pin 240°	0·16
PS 6	D.I.N. 6 Pin	0·17
PS 7	D.I.N. 7 Pin	0·18
PS 8	Jack 2·5mm Screened	0·18
PS 9	Jack 3·5mm Plastic	0·12
PS 10	Jack 3·5mm Screened	0·18
PS 11	Jack ¼″ Plastic	0·15
PS 12	Jack ¼″ Screened	0·22
PS 13	Jack Stereo Screened	0·36
PS 14	Phono	0·10
PS 15	Car Aerial	0·22
PS 16	Co-Axial	0·15

INLINE SOCKETS		
PS 21	D.I.N. 2 Pin (Speaker)	0·14
PS 22	D.I.N. 3 Pin	0·20
PS 23	D.I.N. 5 Pin 180°	0·20
PS 24	D.I.N. 5 Pin 240°	0·20
PS 25	Jack 2·5mm Plastic	0·16
PS 26	Jack 3·5mm Plastic	0·16
PS 27	Jack ¼″ Plastic	0·30
PS 28	Jack ¼″ Screened	0·35
PS 29	Jack Stereo Plastic	0·30
PS 30	Jack Stereo Screened	0·38
PS 31	Phono Screened	0·18
PS 32	Car Aerial	0·22
PS 33	Co-Axial	0·22

SOCKETS		
PS 35	D.I.N. 2 Pin (Speaker)	0·08
PS 36	D.I.N. 3 Pin	0·11
PS 37	D.I.N. 5 Pin 180°	0·11
PS 38	D.I.N. 5 Pin 240°	0·11
PS 39	Jack 2·5mm Switched	0·12
PS 40	Jack 3·5mm Switched	0·12
PS 41	Jack ¼″ Switched	0·20
PS 42	Jack Stereo Switched	0·30
PS 43	Phono Single	0·08
PS 44	Phono Double	0·10
PS 46	Co-Axial Surface	0·10
PS 47	Co-Axial Flush	0·20

LEADS

LS 1	Speaker Lead 2 pin D.I.N. plug to open ends approx 3 metres long (coded)	0·20

CABLES

CP 1	Single Lapped Screen	0·07
CP 2	Twin Common Screen	0·11
CP 3	Stereo Screened	0·12
CP 4	Four Core Common Screen	0·23
PC 5	Four Core Individually Screened	0·30
CP 6	Microphone Fully Braided Cable	0·10
CP 7	Three Core Mains Cable	0·09
CP 8	Twin Oval Mains Cable	0·07
CP 9	Speaker Cable	0·05
CP 10	Low Loss Co-Axial	0·18

CARBON POTENTIOMETERS

Log and Lin
4·7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M

VC 1	Single Less Switch	0·15
VC 2	Single D.P. Switch	0·28
VC 3	Tandem Less Switch	0·46
VC 4	1K Lin Less Switch	0·15
VC 5	100 K anti-Log	0·46

HORIZONTAL CARBON PRESETS

0·1 watt **0·06** each
100, 220, 470, 1K, 2·2K, 4·7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4·7M

SOLVE THOSE STICK PROBLEMS!

with

CYANOACRYLATE C2 ADH

The wonder bond which works in se bond plastic, rubber, metals, tra components, permanently, immediat

OUR PRICE ONLY

for 2 gm. phial

BATTERY HOLDER

Takes 6, HP7's complete with term and lead. **34p.**

WORLD SCOO

JUMBO
SEMICONDUCTOR P

Transistors, Germ. and Silicon R Diodes, Triacs, Thyristors, I.Cs and ALL NEW AND CODED.

APPROX. 100 PIECE

Offering the amateur a fantastic bar and an enormous saving—identifica data sheet in every Pak.

Only £2 p. & p. 20p

RECORD STORAG CARRY CASES

7in EP. 18¾in × 7in × 8in (50 rec

12in LP. 13¾in × 7⅜in × 12¼in (50

CASSETTE CASES £1

Holds 12, 10in×3¾in×5in. Lock ar

8-TRACK CART. CAS

Holds 14, 13in×5in×6in **£1·95**
Holds 24, 13⅜in×8in×5⅜in **£2·70**
Both with lock and handle.

SPECIAL PURCHA

2N3055. Silicon Power Transisto Famous manufacturers out-of-spe free from open and short defects— able! 115W. TO3. Metal Case.

OUR SPECIAL PRICE 8 for

REPANCO TRANSFOR

240V. Primary. Secondary voltag able from selected tappings 4V, 7V, 14V, 15V, 17V, 19V, 21V, 25V, 3 40, 50 and 25V–0–25V.

Type	Amps	Price
MT50/1	1	£2·42
MT50/2	2	£3·30

CARTRIDGES

ACOS
GP91-1SC 200mV at 1·2cm/sec
GP93-1 280mV at 1cm/sec
GP96-1 100mV at 1cm/sec
J-2005 Crystal/Hi Output
J-2010C Crystal/Hi Output Compa
J-2006S Stereo/Hi Output
J-2105 Ceramic/Med Output
J-2203 Magnetic 5mV/5cm/sec, stylus
J-2203S Replacement stylus for ab
AT-55 Audio-technica magnetic 4mV/5cm/sec

CARBON FILM RESIS

The E12 Range of Carbon Film ⅛ watt available in PAKS of assorted into the following groups:
R1 50 Mixed 100 ohms–820 ohms
R2 50 Mixed 1kΩ–8·2kΩ
R3 50 Mixed 10kΩ–82kΩ
R4 50 Mixed 100kΩ–1MΩ
THESE ARE UNBEATABLE
JUST 1p EACH INCL. V.A.T.

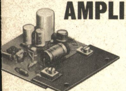
BI-PAK SUPERIOR QU LOW - NOISE CASS

C60, **36p**; C90, **48p**; C120, **60p**.

-the lowest prices!

I-PAK *QUALITY* COMES TO AUDIO!

AL10/AL20/AL30 AUDIO AMPLIFIER MODULES



The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.
The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

Parameter	Conditions	Performance
IONIC DISTORTION	Po = 3 WATTS f = 1KHz	0·25%
IMPEDANCE	—	8–16 Ω
T IMPEDANCE	f = 1KHz	100 kΩ
UENCY RESPONSE —3dB	Po = 2 WATTS	50 Hz–25KHz
TIVITY for RATED O/P	Vs=25V. R1=8 Ω f=1KHz	75mV. RMS
NSIONS	—	3″ × 2½″ = 1″

The above table relates to the AL10, AL20 and AL30 modules. The following table outlines the differences in their working conditions.

Parameter	AL10	AL20	AL30
um Supply Voltage	25	30	30
out for 2% T.H.D. = 8 Ω f = 1KHz)	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.

IO AMPLIFIER ULES

3 watts	**£2·50**
5 watts	**£2·85**
10 watts	**£3·20**

ER SUPPLIES

Use with AL10, AL20, AL30)	**95p**
(Use with AL60)	**£3·25**
PANELS FP 12 with Knobs	**£1·00**

PRE-AMPLIFIERS

PA 12. (Use with AL10, AL20 and AL30)	**£4·35**
PA 100. (Use with AL60)	**£13·15**

TRANSFORMERS

T461 (Use with AL10) **£1·60** P & P 22p
T538 (Use with AL20, AL30) **£2·30** P & P 22p
BMT80 (Use with AL60) **£2·75** P & P 37p

PA12 PRE-AMPLIFIER SPECIFICATION

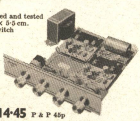
12 pre-amplifier has been designed to match into dget stereo systems. It is compatible with the AL 20 and AL 30 audio power amplifiers and it supplied from their associated power supplies. e two stereo inputs, one has been designed for use eramic cartridges while the auxiliary input will t †Magnetic cartridges. Full details are given in ification table. The four controls are, from left to plume and on/off switch, balance, bass and treble. mm × 84mm × 35mm.

Frequency response—
20Hz–50KHz (—3dD)
Bass control—
± 12dB at 60Hz
Treble control—
± 14dB at 14KHz
*Input 1. Impedance
1 Meg. ohm
Sensitivity 300mV
†Input 2. Impedance
30 K ohms
Sensitivity 4mV

Look for our
SEMICONDUCTOR ADVERTISEMENTS in
ctical Wireless Wireless World Radio Constructor

ALL PRICES INCLUDE V.A.T.

e STEREO 20



reo 20" amplifier is mounted, ready wired and tested piece chassis measuring 20 cm × 14 cm × 5·5 cm. pact unit comes complete with on/off switch ontrol, balance, bass and treble controls, ner, Power supply and Power amps. ely printed front panel and matchol knobs. The "Stereo 20" has been to fit into most turntable plinths nterfering with the mechanism or, vely, into a separate cabinet. power 20w peak. Input 1 (Cer.) nto 1M. Freq. res. 25Hz-25kHz. (Aux.) 4mV into 30K. Harmonic . Bass control ± 12dB at 60Hz 0·25% at 1 watt. Treble con. at 14kHz.

£14·45 P & P 45p

TEAK VENEERED CABINET

o 20 (front board undrilled) Size 10½″ × 8¾″ × 3″, **£3·95** plus 45p postage.

) STEREO HEADPHONES

s impedance. Frequency response 20 to 20,000Hz. Stereo/mono switch and volume **£4·95**

NOW WE GIVE YOU 50w PEAK (25w R.M.S.) *PLUS* THERMAL PROTECTION! The *NEW* AL60 Hi-Fi Audio Amplifier FOR ONLY £4·25

- Max Heat Sink temp 90°C.
- Frequency Response 20Hz to 100KHz
- Distortion better than 0·1% at 1KHz
- Supply voltage 15–50 volts
- Thermal Feedback
- Latest Design Improvements
- Load — 3, 4, 8 or 16 ohms
- Signal to noise ratio 80dB
- Overall size 63mm × 105mm × 13mm

Especially designed to a strict specification. Only the finest components have been used and the latest solid state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F. enthusiast.

STABILISED POWER MODULE SPM80

SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm.
These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems, Public Address, Intercom Units, etc. Handbook available 10p **PRICE £3·25**

TRANSFORMER BMT80 £2·75 p. & p. 40p

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATION

Frequency Response	20Hz—20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs: 1. Tape Head	3·25 mV into 50K Ω
2. Radio, Tuner	75 mV into 50K Ω
3. Magnetic P.U.	3 mV into 50K Ω

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

Bass Control	± 15dB at 20Hz
Treble Control	± 15dB at 20KHz
Filters: Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than —65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm × 82mm × 35mm

ONLY £14·25

MK 60 AUDIO KIT

Comprising: 2 × AL60, 1 × SPM80, 1 × BTM80, 1 × PA 100, 1 front panel, 1 kit of parts to include on-off switch, neon indicator, stereo headphone sockets plus instruction booklets. **Complete Price: £29·75** plus 45p postage.

TEAK 60 AUDIO KIT

Comprising: Teak veneered cabinet size 16¾″ × 11½″ × 3¾″, other parts include aluminium chassis, heatsink and front panel bracket, plus back panel and appropriate sockets, etc. **Kit price: £9·95** plus 45p postage.

Giro No. 388-7006

Please send all orders direct to warehouse and despatch department

BI-PAK

P.O. BOX 6, WARE · HERTS

Postage and packing add 20p Overseas add extra for airmail.
Minimum order 55p. Cash with order please.

Guaranteed Satisfaction or Money Back

CRESCENT RADIO LTD.

11-15 & 17 MAYES ROAD, LONDON N22 6TL
(also) 13 SOUTH MALL, EDMONTON, N.9

MAIL ORDER DEPT.
11 MAYES ROAD, LONDON N22 6TL
Phone 888 3206 & (EDM.) 803 1685

ADD LUXURY TO YOUR CAR

WITH A MOTOR DRIVEN CAR AERIAL

Spec.: 5 Section
Extended Length 100cm
Length under Fender 40cm
Cable Length 120cm

Supplied complete with Fixing Bracket and Control Switch. **£7·50** plus 25p P. & P.

"CRESCENT BEAT BRITE" SINGLE CHANNEL SOUND TO LIGHT UNIT This fantastic little box approx. 4" × 3" × 2½" when connected to the output of a sound source from 1 to 100 watts produces a psychedelic light display of up to 1000 watts. Complete with a sensitive level control the unit is fused and cannot harm your amplifier.
A Bargain at **£7·50** plus 10p.

MINIATURE RELAYS

Brand new range of British made relays, size: 1¼in × 1in × ¾in. All two changeovers with 250V 1·5A contacts and suitable for fitting on 0·1m veroboard.

Type	Volts	Current	Ohms	
27/A	12V	17M/A	700	**All**
21/A	12V	28M/A	430	**£1·30**
12/A	6V	33M/A	185	**each**

200/250V Mains Relay

Heavy duty contacts 2,500 ohm coil. All new and unused D.P.D.T. mains relays **50p**, Carr. free. Special quantity **£40** per 100 off.

MIDGET MAINS TRANSFORMER

Varnish Impregnated
Size 45mm × 36mm × 31mm

PRI 240V
Sec 3.0·3 100mA
Sec 6·0·6 100mA
Sec 9·0·9 100mA
Sec 12·0·12 100mA
Sec 20·0·20 100mA
£1·23 10p P. & P.

CRESCENT BUBBLE LIGHT SHOW

This budget system compares very favourably with more sophisticated and higher priced models.
Specification:
Projector—150W convection cooled. At 30ft the projected image is 16ft.
Motor—1 rev. per 2 min.
Liquid Wheel—6in diameter multi colour.
The motor is fitted to the projector and can only be purchased as a single unit.
The liquid wheel is our standard model and may be purchased separately.
A bargain at: Projector, **£15**; Wheel, **£5**; Total **£20.** Plus 75p carr.

CABLE LESS SOLDERING IRON WAHL "ISO-TIP"

- ★ Completely portable.
- ★ Solders up to 150 joints per charge.
- ★ Recharges in its own stand.
- ★ Fine tip for all types of soldering.
- ★ Only 8in long and weighs just 6 ozs.

OUR PRICE **£9·75**
(Spare bits are available)

"CRESCENT" 100 WATT R.M.S. ALL PURPOSE AMPLIFIER U. BUILD. IT

We supply the three modules for you to build this Disco-Group-P.A. amplifier into the cabinet of your choice.

★ THE POWER AMP MODULE

170W r.m.s. sq. wave 300W instantaneous peak into 8 ohm (60W into 16 ohm).

★ THE PRE-AMP MODULE

Four control pre-amp, Vol. Bass, Treble. Middle controls. Designed to drive most amplifiers using F.E.T. first stage.

★ THE POWER SUPPLY

Is supplied complete with the mains transformer. Complete fixing instructions are supplied and no technical knowledge is required to connect the three ready wired modules. A fantastic bargain. **£25**, carr. 75p. Send S.A.E. for further details on this or our ready built amplifiers.

12–0–12V 500M/A

240V primary transformer bargain. Approx. size: 60mm × 40mm × 50mm; fixing centres: 75mm. Our price **£1·20.**

18V 500M/A

240V primary. Approx. size: 60mm × 40mm × 50mm. fixing centres: 75mm. Our Price **£1** each

LOW NOISE, LOW PRICE CASSETTES

Good quality tape in well made screw type cassettes. Presented in single plastic cases.

C60 **31p** C90 **42p** C120 **53p**

10% discount on ten or more cassettes of one type.

ABS PLASTIC BOXES

Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels. 1005, 105mm × 73mm × 45mm **51p**; 1006, 150mm × 75mm × 47mm **66p**; 1007, 184mm × 124mm × 60mm **96p**; 1021, 106mm × 74mm × 45mm (sloping front) **50p.**

BARGAIN BOARDS

Components galore for the experimenter. Ex-Computer boards with resistors, capacitors and useful transistors—at least 4 transistors per board. Five boards **£1.**

2in. PANEL METERS

Size 59mm × 46mm

0·50μA —ME6
0·100μA—ME7
0·500μA—ME8
0·1mA —ME9
0·5mA —ME10
0·10mA—ME11
0·50mA—ME12
0·100mA—ME13
0·500mA—ME14
0·1A —ME15
0·50V —ME16
0·300V a.c.—ME17
S meter —ME18
V.U. meter—ME19

£3 each. 10p P. & P.

POWER PACKS

PP1 Switched 3-6-7½-9V 400M/A Transistor and Zener Stabilised On/Off switch and Polarity Reversal switch, in a black metal case, **£5·25** each.
PP2 Switched 6-7½-9V Battery Eliminator. Approx. size 2¾in × 2¼in × 3¼in. Ideal for cassette recorders, **£3·25.**
PP3 Car converter. From 12V Pos. or Neg. to = 6-7½-9V. Easy to fit and transistor regulated, **£3·90.**

3 KILOWATTS PSYCHEDELIC LIGHT CONTROL UNIT

Three Channel: Bass, Middle, Treble. Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier, and connect three 250V up to 1000W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed.)

£18·50 plus 38p P. & P.

MINI LOUDSPEAKERS

2¼in 80 ohm, **50p**; 2¼in 40 ohm, **50p**. Please include 5p P. & P. on each L.S.

U.K. CARRIAGE
15p UNLESS
OTHERWISE STATED

VAT
8% VAT TO BE ADDED
TO ALL ORDERS

SEND 30p FOR A
CRESCENT
CATALOGUE

RST VALVE MAIL ORDER CO.

16a WELLFIELD ROAD, LONDON SW16 2BS
SPECIAL EXPRESS MAIL ORDER SERVICE
Express postage 10p per order.
INTEGRATED CIRCUITS 6p + 1p each added.

	£p
1N21	0·17
1N23	0·35
1N85	0·88
1N253	0·50
1N256	0·50
1N645	0·16
1N725A	0·20
1N914	0·06
1N4007	0·12
1S113	0·25
1S202	0·23
2G371	0·40
2G381	0·22
2G414	0·30
2G417	0·25
2N404	0·22
2N697	0·16
2N698	0·30
2N706	0·12
2N706A	0·12
2N708	0·15
2N709	0·40
2N1091	0·55
2N1131	0·25
2N1132	0·24
2N1302	0·18
2N1303	0·18
2N1304	0·28
2N1305	0·22
2N1306	0·28
2N1307	0·28
2N1308	0·28
2N2147	0·78
2N2148	0·60
2N2160	0·78
2N2218	0·23
2N2219	0·25
2N2369A	0·16
2N2444	1·99
2N2613	0·28
2N2646	0·50
2N2904	0·20
2N2904A	0·25
2N2906	0·20
2N2907	0·23
2N2924	0·13
2N2925	0·15
2N2926	0·12
2N3054	0·48
2N3055	0·45
2N3702	0·11
2N3705	0·15
2N3706	0·11
2N3707	0·13
2N3709	0·10
2N3710	0·11
2N3711	0·11
2N3819	0·38
2N4289	0·30
2N5027	0·53
2N5088	0·33
2S301	0·59
2S304	1·15
2S501	0·75
2S703	1·00
AA129	0·20
AAZ12	0·75
AAZ13	0·12
AC107	0·51
AC126	0·25
AC127	0·25
AC128	0·15
AC187	0·21
AC188	0·20
ACY17	0·40
ACY18	0·27
ACY19	0·27
ACY20	0·22
ACY21	0·22
ACY22	0·16
ACY27	0·25
ACY28	0·25
ACY39	0·78
ACY40	0·22
ACY41	0·22
ACY44	0·32
AD140	0·50
AD149	0·50
AD161	0·44
AD162	0·44
AF106	0·30
AF114	0·25
AF115	0·25
AF116	0·25
AF117	0·24
AF118	0·57
AF119	0·20
AF124	0·30
AF125	0·30
AF126	0·30
AF127	0·30
AF139	0·41
AF178	0·55
AF179	0·65
AF180	0·55
AF181	0·50
AF186	0·48
AFZ11	1·15
AFZ12	2·00
ASY26	0·25
ASY27	0·33
ASY28	0·25
ASY29	0·30
ASY36	0·25
ASY50	0·20
ASY51	0·40
ASY53	0·20
ASY55	0·20
ASY62	0·25
ASY66	0·33
ASZ21	1·00
ASZ23	0·75
AU104	1·00
AUY10	1·00
BC107	0·14
BC108	0·13
BC109	0·14
BC113	0·15
BC115	0·20
BC116	0·20
BC116A	0·23
BC118	0·20
BC121	0·20
BC122	0·20
BC125	0·68
BC126	0·65
BC140	0·55
BC147	0·10
BC148	0·08
BC149	0·10
BC157	0·14
BC158	0·12
BC160	0·63
BC169	0·14
BCY31	0·45
BCY32	0·85
BCY33	0·38
BCY34	0·45
BCY38	0·55
BCY39	1·50
BCY40	0·80
BCY42	0·30
BCY70	0·18
BCY71	0·22
BCZ10	0·60
BCZ11	0·65
BD121	1·00
BD123	1·00
BD124	0·65
BDY11	1·45
BF115	0·20
BF167	0·25
BF173	0·28
BF181	0·35
BF184	0·22
BF185	0·22
BF194	0·10
BF195	0·13
BF196	0·15
BF197	0·15
BFS61	0·25
BFS98	0·25
BFX12	0·20
BFX13	0·26
BFX29	0·28
BFX30	0·28
BFX35	0·98
BFX63	0·50
BFX84	0·25
BFX85	0·28
BFX86	0·25
BFX87	0·25
BFX88	0·24
BFY10	1·00
BFY11	0·50
BFY17	0·40
BFY18	0·45
BFY19	0·55
BFY24	0·45
BFY44	1·00
BFY50	0·21
BFY51	0·20
BFY52	0·20
BFY53	0·17
BFY64	0·36
BFY90	0·81
BSX27	0·50
BSX60	0·93
BSX76	0·18
BSY26	0·17
BSY27	0·20
BSY51	0·50
BSY95A	0·12
BSY95	0·12
BT102/500R	0·75
BTY42	0·92
BTY79/100R	0·75
BTY79/400R	1·10
BY100	0·27
BY126	0·14
BY127	0·12
BY182	0·85
BY213	0·25
BYZ10	0·45
BYZ11	0·40
BYZ12	0·40
BYZ13	0·42
BYZ15	1·25
BYZ16	0·60
BZY88	0·10
C111	0·55
CRS1/05	0·30
CRS1/40	0·45
CS4B	1·90
CS10B	3·50
DD000	0·15
DD003	0·15
DD006	0·25
DD007	0·40
DD008	0·38
GD3	0·33
GD4	0·10
GD5	0·38
GD8	0·25
GD12	0·10
GET102	0·50
GET103	0·40
GET113	0·35
GET114	0·30
GET115	0·90
GET116	0·85
GET120	0·50
GET872	0·30
GET875	0·40
GET880	0·60
GET881	0·25
GET882	0·35
GET885	0·40
GEX44	0·08
GEX45/1	0·45
GEX941	0·45
GJ3M	0·50
GJ4M	0·50
GJ5M	0·25
GJ7M	0·50
HG1005	0·50
HS100A	0·20
MAT100	0·20
MAT101	0·25
MAT120	0·20
MAT121	0·25
MJE520	0·63
MJE2955	1·27
MJE3055	0·77
MJE340	0·47
MPF102	0·40
MPF103	0·36
MPF104	0·35
MPF105	0·36
NKT128	0·45
NKT129	0·30
NKT211	0·25
NKT213	0·25
NKT214	0·24
NKT216	0·40
NKT217	0·45
NKT218	1·13
NKT219	0·33
NKT222	0·30
NKT224	0·25
NKT251	0·24
NKT271	0·20
NKT272	0·20
NKT273	0·20
NKT274	0·20
NKT275	0·25
NKT277	0·20
NKT278	0·25
NKT301	0·85
NKT304	0·75
NKT403	0·70
NKT404	0·66
NKT678	0·30
NKT713	0·30
NKT773	0·25
NKT777	0·38
OA5	0·72
OA6	0·12
OA47	0·08
OA70	0·10
OA71	0·20
OA73	0·15
OA74	0·15
OA79	0·10
OA81	0·18
OA85	0·15
OA86	0·15
OA90	0·07
OA91	0·07
OA95	0·07
OA200	0·08
OA202	0·06
OA210	0·20
OA211	0·35
OAZ200	0·50
OAZ201	0·45
OAZ202	0·45
OAZ203	0·45
OAZ204	0·45
OAZ205	0·45
OAZ206	0·45
OAZ207	0·45
OAZ208	0·40
OAZ209	0·40
OAZ210	0·40
OAZ211	0·40
OAZ222	0·45
OAZ223	0·45
OAZ224	0·45
OAZ241	0·25
OAZ242	0·15
OAZ244	0·25
OAZ246	0·15
OAZ290	0·38
OC16	1·00
OC16T	1·00
OC19	0·50
OC22	1·00
OC23	1·25
OC24	1·10
OC25	0·40
OC26	0·40
OC28	0·66
OC29	0·65
OC30	0·40
OC35	0·55
OC36	0·60
OC41	0·35
OC42	0·40
OC43	0·70
OC44	0·20
OC44M	0·17
OC45	0·20
OC45M	0·18
OC46	0·27
OC57	0·60
OC58	0·60
OC59	0·60
OC66	0·50
OC70	0·18
OC71	0·18
OC72	0·28
OC73	0·50
OC74	0·30
OC75	0·30
OC76	0·30
OC77	0·54
OC78	0·25
OC79	0·30
OC81	0·29
OC81D	0·28
OC81M	0·20
OC81DM	0·18
OC81Z	0·45
OC82	0·23
OC82D	0·25
OC83	0·27
OC84	0·30
OC114	0·38
OC122	1·00
OC123	1·10
OC139	0·40
OC140	1·14
OC141	0·80
OC169	0·20
OC170	0·30
OC171	0·30
OC200	0·54
OC201	1·00
OC202	0·90
OC203	0·55
OC204	0·65
OC205	1·00
OC206	1·10
OC207	1·00
OC460	0·20
OC470	0·30
OCP71	1·20
ORP12	0·60
ORP60	0·55
ORP61	0·48
SX68	0·20
SX631	0·45
SX635	0·55
SX640	0·75
SX641	0·75
SX642	0·60
SX644	0·85
SX645	0·85
TIC44	0·29
V15/30P	0·75
V30/201P	0·75
V60/201	0·50
V60/201P	0·75
XA101	0·10
XA102	0·18
XA151	0·15
XA152	0·15
XA161	0·25
XA162	0·25
XB101	0·43
XB102	0·30
XB103	0·35
XB113	0·30
XB121	0·43
ZS170	0·10
ZS271	0·18
ZT21	0·25
ZT43	0·25
ZTX107	0·12
ZTX108	0·08
ZTX300	0·13
ZTX304	0·24
ZTX500	0·13
ZTX503	0·16
ZTX531	0·25

INTEGRATED CIRCUITS

7400	0·16
7401	0·16
7402	0·16
7403	0·16
7404	0·26
7405	0·22
7406	0·42
7407	0·42
7408	0·28
7409	0·28
7410	0·16
7411	0·25
7412	0·30
7413	0·36
7416	0·36
7417	0·36
7420	0·16
7422	0·25
7423	0·37
7425	0·37
7427	0·37
7428	0·40
7430	0·16
7432	0·37
7433	0·37
7437	0·37
7438	0·37
7440	0·22
7441AN	0·92
7442	0·79
7450	0·16
7451	0·16
7453	0·16
7454	0·16
7460	0·16
7470	0·36
7472	0·88
7473	0·41
7474	0·42
7475	0·59
7476	0·45
7480	0·60
7482	0·87
7483	1·10
7484	1·00
7486	0·47
7490	0·55
7491AN	1·00
7492	0·70
7493	0·70
7494	0·80
7495	0·80
7496	0·95
7497	3·87
74100	1·89
74107	0·45
74110	0·58
74111	0·86
74118	0·90
74119	1·68
74121	0·50
74122	0·70
74123	1·00
74141	0·90
74145	1·26
74150	1·75
74151	1·00
74154	2·00
74155	1·00
74156	1·00
74157	0·95
74170	2·52
74174	1·57
74175	1·10
74176	1·26
74190	2·00
74191	2·00
74192	2·00
74193	2·00
74194	1·30
74195	1·10
74196	1·20
74197	1·20
74198	2·77
74199	2·52

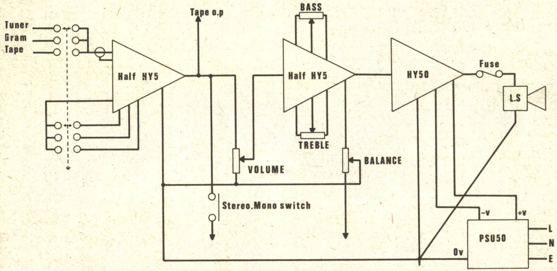
Plug in sockets —low profile
14 pin DIL 0·15
16 pin DIL 0·17

Open daily to callers: Mon.-Fri. 9 a.m.-5 p.m.
Valves, Tubes and Transistors • Closed Sat. 1 p.m.-3 p.m.
Terms C.W.O. only • Tel. 01-677 2424-7
All orders subject to V.A.T. at 8% rate. This must be added to the total order including postage.

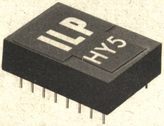
Prices correct when going to press.

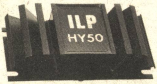
I.L.P. (Electronics) Ltd

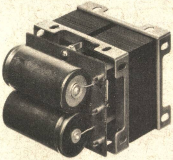
SHEER SIMPLICITY!



MONO ELECTRICAL CIRCUIT DIAGRAM WITH INTERCONNECTIONS FOR STEREO SHOWN







The HY5 is a complete mono hybrid preamplifier, ideally suited for both mono and stereo applications. Internally the device consists of two high quality amplifiers—the first contains frequency equalisation and gain correction, while the second caters for tone control and balance.

TECHNICAL SPECIFICATION
Inputs: Magnetic Pick-up 3mV RIAA; Ceramic Pick-up 30mV; Microphone 10mV; Tuner 100mV; Auxillary 3–100mV; Input/impedance 47kΩ at 1kHz. **Outputs:** Tape 100mV; Main output 0db (0·775V RMS). **Active Tone Controls:** Treble ±12db at 10kHz; Bass ±12db at 100Hz. **Distortion:** 0·5% at 1kHz. **Signal/Noise Ratio:** 68db. **Overload Capability:** 40db on most sensitive input. **Supply Voltage:** ±16–25V.

PRICE £4·50 + 36p VAT
P. & P. free

The HY50 is a complete solid state hybrid Hi-Fi amplifier incorporating its own high conductivity heatsink hermetically sealed in black epoxy resin. Only five connections are provided, input, output, power lines and earth.

TECHNICAL SPECIFICATION
Output Power: 25W RMS into 8Ω. **Load Impedance:** 4–16Ω. **Input Sensitivity:** 0db (0–775V RMS). **Input Impedance:** 47kΩ. **Distortion:** Less than 0·1% at 25W typically 0·05%. **Signal/Noise Ratio:** Better than 75db. **Frequency Response:** 10Hz–50kHz ± 3db. **Supply Voltage:** ±25V. **Size:** 105 × 50 × 25mm.

PRICE £5·98 + 48p VAT
P. & P. free

The **PSU50** incorporates a specially designed transformer and can be used for either mono or stereo systems.

TECHNICAL SPECIFICATIONS
Output voltage: ±**25V. Input voltage:** 210–240V. **Size:** L.70, D.90, H.60mm.

PRICE £6 + 48p VAT
P. & P. FREE

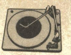
TWO YEARS' GUARANTEE ON ALL OUR PRODUCTS

I.L.P. Electronics Ltd.
Crossland House,
Nackington, Canterbury,
Kent CT4 7AD.
Tel. (0227) 63218

Please Supply ....
Total Purchase Price ....
I Enclose Cheque ☐ Postal Orders ☐ Money Order ☐
Please debit my Access account ☐ Barclaycard account ☐
Account number ....
Name and Address ....
Signature ....

ALL OUR PRICES INCLUDE V.A.T.

BSR HI-FI AUTOCHANGER
STEREO & MONO



Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250V. Size 13½ × 11¼in. Above motor board 3¾in. Below motor board 2½in.

with STEREO and MONO XTAL **£7·95** Post 45p.

PORTABLE PLAYER CABINET

Modern design. Rexine covered. Large front grille. Lift-up Lid. Chrome fittings. Approx. size 17in × 15in × 7in. Few only in red and black rexine. Motor board cut for Garrard deck **£4·50** Post 50p

BSR JUNIOR SINGLE PLAYER

Heavy duty 4-speed motor with separate pick-up arm fitted LP/78 turnover mono compatible cartridge. **£4.95** Post 25p

R.C.S. DISCO DECK SINGLE RECORD PLAYER

Fitted with auto stop. Compatible cartridge. Baseplate. Size 11in × 8½in. Turntable. Size 7in diameter. A/C mains. 200/250V motor has a separate winding 14 volt to power a small amplifier. Three speeds. Plays all records.

£5·50 Post 25p

SOLID MAHOGANY PLINTH

Post 45p

With P.V.C. Cover. Cut out for most B.S.R. or Garrard decks. Size 12½ × 14¾ × 7½in. **£6·50**

COMPLETE STEREO HI-FI SYSTEM

Two full size loudspeakers 13¾ × 10 × 3¾in. Player unit clips to loudspeakers making it extremely compact, overall size only 13¾ × 10 × 8½in., 3 watts per channel, plays all records 33 r.p.m., 45 r.p.m. Separate volume and tone controls. 240V AC Mains.

Attractive Teak finish Weight 13 lb.

Bargain Price **£25** 85p Carriage

SPECIAL OFFER! SMITH'S CLOCKWORK 15 AMP TIME SWITCH 0 TO 60 MINUTES

Single pole two-way Surface mounting with fixing screws. Will replace existing wall switch to give light for return home, garage, automatic anti-burglar lights, etc. Variable knob. Turn on or off at full or intermediate settings. Fully insulated. Makers' last list price £4·50. Brand new and fully guaranteed.

OUR PRICE **£2·20** Post 25p

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in sides 6 × 4in 45p; 8 × 6in 53p; 10 × 7in 65p; 12 × 8in 85p; 14 × 9in 90p; 16 × 6in 90p; 12 × 3in 50p; 16 × 10in £1.
ALUMINIUM BOXES 3 × 3 × 3in 60p; 4 × 4 × 4in 70p; 6 × 4 × 4in 80p; 9 × 4 × 4in £1; 12 × 4 × 4in £1·30.
ALUMINIUM PANELS 18 s.w.g. 6 × 4in 12p; 8 × 6 in 19p; 14 × 3in 20p; 10 × 7in 24p; 12 × 5in 25p; 12 × 8in 34p; 16 × 6in 34p; 14 × 9in 40p; 12 × 12in 47p; 16 × 10in 60p.
1¼ inch **DIAMETER WAVECHANGE SWITCHES**, 45p ea.
2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way.
1 p.1. 2-way, or 4 p. 2-way, or 4 p. 3-way.
TOGGLE SWITCHES, sp. 20p; dp. 25p; dp. dt. 30p.

BRITISH FM/VHF TUNING HEART

88 to 108 Mc/s British made. 2 Transistors ready aligned —requires 10·7 Mc/s I.F. Complete with tuning gang. Connections supplied but some technical experience essential.

Our price £3·95 Post 20p

SUITABLE I.F. STRIP £4·95. DECODER £4·95

R.C.S. STEREO FM TUNER BRITISH MADE

This completely cased mains powered Hi-Fi Tuner with brushed aluminium facia is British made using the latest circuitry. **£23** Post 45p.

R.C.S. GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE

Ideal for Mike, Tape, P.U., Guitar, etc. Can be used with Battery 9-12V or H.T. line 200-300V d.c. operation. Size: 1¾ x 1¼ x ¾ in. Response 25 c/s to 25 kc/s. 26 dB gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **£1·25** Post 10p

R.C.S. POWER PACK KIT

12 VOLT, 750mA. Complete with printed circuit board and assembly instructions. **£2·95** Post 25p
12 VOLT 300mA KIT, £2·75. 9 VOLT 1 AMP KIT, £2·95.

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350V	14p	250/25V	14p	50+50/300V	50p
4/350V	14p	500/25V	20p	32+32/350V	35p
8/350V	22p	100+100/275V	65p	32+32/450V	60p
16/350V	30p	150+200/275V	70p	350+50/325V	55p
32/500V	50p	8+8/450V	22p	16+16+16/275V	45p
25/25V	10p	8+16/450V	25p	32+32+32/350V	65p
50/50V	10p	16+16/450V	40p	900/350V	95p
100/25V	10p	32+32/350V	40p	4700/63V	95p

LOW VOLTAGE ELECTROLYTICS.
1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p.
500mF 12V 15p; 25V 20p; 50V 30p.
1000mF 12V 20p; 25V 35p; 50V 47p; 100V 70p.
2000mF 6V 25p; 25V 42p; 50V 57p.
2500mF 50V 62p; 3000mF 25V 47p; 50V 65p.
5000mF 6V 25p; 12V 42p; 25V 75p; 35V 85p; 50V 95p.
CERAMIC 1pF to 0·01mF, 4p. Silver Mica 2 to 5000pF, 4p.
PAPER 350V-0·1 7p; 0·5 18p; 1mF 15p; 2mF 150V 15p. 500V-0·001 to 0·05 4p; 0·1 10p; 0·25 8p; 0·47 25p.
TWIN GANG. "0-0" 208pF+176pF, £1.20p.
Slow motion drive 365pF+365pF with 25pF+25pF, 50p; Twin 500pF 75p. Twin 410pF 50p. Twin 120pF 50p.
SHORT WAVE SINGLE. 25pF, 45p; 50pF, 55p.
NEON PANEL INDICATORS 250V AC/DC. Amber 30p.
RESISTORS. ¼W, ½W, 1W. 20% 1p; 2W, 5p. 10 Ω to 10M.
HIGH STABILITY. ½W 2% 10 ohms to 6 meg., 10p.
Ditto 5%. Preferred values 10 ohms to 10 meg., 4p.
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K 10p each.
TAPE OSCILLATOR COIL Valve type 35p.
FERRITE ROD 8 × ⅜in 20p; 6 × ⅜in 20p; 3 × ⅜in 10p.

MAINS TRANSFORMERS

ALL POST 25p each

250-0-250 80mA. 6·3V 2 amp	£2·50
250-0-250 80 mA. 6·3V 3·5A 6·3V 1A or 5V 2A	£4·00
350-0-350 80 mA 6·3V 3·5A, 6·3V 1A or 5V 2A	£5·00
300-0-300V 120mA, 6·3V 4A C.T.; 6·3V 2A	£6·00
MINIATURE 200V 20mA, 6·3V 1A 2½ × 2½ × 2in	75p
MIDGET 220V 45mA, 6·3V 2A 2¾ × 2½ × 2in	90p
HEATER TRANS. 6·3V ½ amp 85p, 3 amp	£1.20p

GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V £4·00
1 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £4·00
2 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £6·00
5 amp, 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £9·75
10, 30, 40V 2 amp. £2.20; 20V 3 amp. £2. 5, 8, 13V, 5 amp. £1·50; 6-0-6V 500mA 90p; 9V 1 amp. 95p; 12V 300mA 75p; 12V 500mA 85p; 12V 750mA 95p; 40V 3 amp. £2·50; 22-0-22V 4 amp. £3; 16V ½ amp. 95p; 16V 2 amp. £1·85; 5V, 8V, 10V, 16V ½ amp. £1·60.
AUTO TRANSFORMERS. 115V to 230V or 230V to 115V 150W £4·00; 500W £7·50; 750W £15; 1000W £18.
CHARGER TRANSFORMERS. 200/250V, 4 amp £4·00.
BATTERY CHARGERS. Ready built with leads and clips, 4 amp £4; 5 amp. £4·50.
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12V outputs. 1½ amp 40p; 2 amp 55p; 4 amp 85p.

MAINS ISOLATING TRANSFORMER

Primary 0-110-240V. Secondary 0-240V 3 amps 720 watts. Insulated terminals. Varnish impregnated. Fully enclosed in steel case with fixing feet. Famous make (Value £19) OUR PRICE **£12** Carr. 95p
Can be used as 800 watt auto transformers 240-110V.

VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 20p. D.P. 35p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P. Transistor 25p.

80 Ohm Coax 5p yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd £2·00; 60 yd £3·00.
FRINGE LOW LOSS Ideal 625 and colour. **10p** per yd

Wire Wound controls 1¼in diam. 3 Watts. 10 ohms to 100K British Made with long spindles ¼in dia. 85p each.
DUAL CONCENTRIC POT 500K LOG AND 500K LIN D.P. switch. Inner spindle 3¼in; outer spindle 2¼in 75p.

E.M.I. 13½ × 8in. SPEAKER SALE!

With twin tweeters. And crossover. 10 watt. State 3 or 8 or 15 ohm. As illustrated. **£4·50** Post 25p

With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45-60 c/s. Flux 10,000 gauss. **£2·95**
State 3 or 8 or 15 ohm. Post 25p
13 × 8in Bass unit 20 watt rubber cone surround £5·50

LOUDSPEAKER FRONT GRILLES

Teakwood strips mounted on cloth backing, easily glued on to baffle to modernise cabinets.
Size 18½ in × 10½in. **75p** Or size 10½in × 7⅞in. **45p**

E.M.I. 6½in. HI-FI WOOFER

8 ohm. 10W. Large ceramic magnet. Special Rubber cone surround. Frequency response 30-12,000 c/s. Ideal P.A. Columns. Hi-Fi Enclosure Systems, etc. **£4**
Suitable Cabinet 12 × 8 × 6 £4 Suitable Tweeter £2

ELAC CONE TWEETER

The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 c/s to 18,000 c/s. Size 3½ × 3½ × 2in deep. Rating 10W, 3 ohm.

Crossover £1·60 **£1·90** Post 20p.

GOODMANS 8 in. WOOFER

8 ohm 12 watt. Deep cone. Heavy ceramic magnet. Bass resonance 35 cps. Frequency response 30-8,000 cps. Ideal bass unit for Hi-Fi system. **£3·75**

SPECIAL OFFER LOUDSPEAKERS

3 ohm, 2½in; 2⅝in; 3½in; 5in.
8 ohm, 2¼.n; 2¾in; 5in × 3in; 3in; 4in; 5in; 6 × 4in.
15 ohm, 3½in; 5in; 6 × 4in; 5 × 3in; 7 × 4in; 8 × 5in.
25 ohm, 2½in; 5 × 3in; 5in; 6 × 4in.
35 ohm, 3in; 5in.
80 ohm, 2¼in; 2¾in. 120 ohm 3in.

£1 EACH

LOUDSPEAKERS P.M. 3 OHMS. 7 × 4in £1·25; 6½in £1·50; 8 × 5in £1·60; 8in £1·75; 10 × 6in £1·90; 10in £2·50
RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in diameter 4W £2·50, 10 in diameter 5W £2·95; Post 25p. 12in diameter, 6W, £3·50; 3 or 8 or 15 ohm models.
SPEAKER COVERING MATERIALS. Samples Large S.A.E.
Horn Tweeters 2-16Kc/s. 8W 8 ohm or 15 ohm £2·50.
De Luxe Horn Tweeters 2-18Kc/s, 15W, 15 ohm £4·00.
TWO-WAY 3,000 c.p.s. CROSSOVERS 3, 8 or 15 ohm £1·60.

CASSETTE MACHINE MOTOR. 6 Volt. Will replace many types £1·25.

R.C.S. 3 WAY CROSSOVER

Complete with 12 ft. twin lead fitted with din speaker plug. Ready assembled with leads for speakers, bass, mid and tweeter. Crossover frequencies—950 cps and 3,000 cps. **£1·95**

VALVE OUTPUT TRANSFORMER 50p.
MIKE TRANSFORMER MU metal 100-1 £1·25.
PUSH-PULL VALVE OUTPUT TRANSFORMERS.
50 watt .... £12·50 100 watt .... £15·00

ELECTRO MAGNETIC PENDULUM MECHANISM

1·5V d.c. operation over 200 hours continuous on SP2 battery, fully adjustable swing and speed. Ideal displays, teaching electro magnetism or for metronome, strobe, etc. **95p** Post 20p

R.C.S. RECORD PLAYER AMPLIFIER

2 stage triode pentode valve. 3 watts output. Volume on/off and tone controls. Printed circuit A.C. mains complete and tested. **£4·50** Post 35p
Complete with speaker.

COAXIAL PLUG 10p. **PANEL SOCKETS** 10p. **LINE 18 OUTLET BOXES, SURFACE MOUNTING** 40p.
BALANCED TWIN RIBBON FEEDER 300 ohms, 7p yd.
JACK SOCKET Std. open-circuit 14p. closed circuit 23p; Chrome Lead Socket 45p. Phono Plugs 7p. Phono Socket 7p
JACK PLUGS Std. Chrome 20p; 3·5mm Chrome 15p **DIN SOCKETS** Chassis 3-pin 10p; 5-pin 10p **DIN SOCKETS** Lead 3-pin 25p; 5-pin 25p. **DIN PLUGS** 3-pin 25p; 5-pin 25p.
VALVE HOLDERS 5p; **CERAMIC** 10p; **CANS** 5p.

ALL PRICES INCLUDE VAT ● 20p MINIMUM POST AND PACKING ● CALLERS WELCOME ●

RADIO COMPONENT

Illustrated Brochure, Radio Books & Component Lists 10p Written guarantee.

ALL OUR PRICES INCLUDE V.A.T.

E.M.I. WOOFER AND TWEETER KIT

£5·75 THE PAIR, Post 45p. (Available separately. Woofer £4·25; Tweeter £1·90)

Comprising a fine example of a Woofer 10¾ × 6½in with a massive Ceramic Magnet, 44oz Gauss 13,000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3½in square has a special lightweight paper cone and magnet flux 10,000 lines. Crossover condenser and full instructions supplied.

Impedance Standard	8 ohms
Maximum power	12 watts
Useful Response	35 to 18,000 cps
Bass Resonance	45 cps

SUITABLE ENCLOSURE 20 × 13 × 9in. MODERN DESIGN. TEAK WOOD FINISH. **£10·50** Post 75p

ANOTHER R.C.S. BARGAIN !

ELAC 9 × 5in. HI-FI SPEAKER TYPE 59RM

This famous unit now available, 10 watts, 8 ohm.

Price **£2·95** Post 25p

8″ or 10″ x 6″ ELAC HI-FI SPEAKER

Dual cone plasticised roll surround. Large ceramic magnet. 50–16,000 cps. Bass resonance 55 cps. 8 ohm impedance. 10 watts. **£3·75**

10in round £4·50.

TEAK VENEER HI-FI SPEAKER CABINETS
Fluted Wood Fronts

MODEL "A". 20 × 13 × 9in For 12 in. dia. or 10in speaker. **£10·50** Post 75p

MODEL "B". 16 × 10 × 7in For 13 × 8in. or 8 in. speaker **£6·60** Post 45p

MODEL "4C". 30 × 20 × 12in. Reflex cabinet will accept 1–12in. bass unit, 1–5in. mid range, 1–3in. tweeter. Teak finish. Grooved front **£18·50** Carr. £2

LOUDSPEAKER CABINET WADDING 18in wide, 20p ft.

GOODMANS CONE TWEETER

3½in. diam. 18,000 C.P.S. 25 WATTS 8 Ω **£3·30**

BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt battery operated. **£4·50**

STEREO VERSION OF ABOVE £5·95.

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated. Mains Supply £3. **£3·95**

THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER. Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/250V. Leaflet S.A.E. **£3·75** Post 20p

WAFER THIN HEATING ELEMENTS

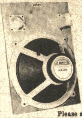
OFFERING 1001 USES for every type of heating and drying applications in the home, garage, greenhouse factory (available in manufacturing quantities). Approx size 10⅞ × 8¼ × 1/16 in. Operating voltage 200/250V. a.c· 250 watts approx. Printed circuit element enclosed in asbestos fitted with connecting wires. Completely flexible providing safe Black heat. British-made for use in photocopiers and print drying equipment.

Ideal for home handymen and experimenters. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos, etc., to make efficient clothes dryers, towel rails—ideal for airing cupboards. Ideal for anti-frost device for the garage—preventing frozen radiators or acting as oil sump heater. Use in greenhouse for seed raising and plant protection. Invaluable aid for bird houses, incubators, etc., etc. Can be used in series for lower heat. Or in parallel for higher heat applications.

ONLY **40p** EACH (FOUR FOR £1·50)

ALL POST PAID—Discounts for quantity.

BAKER MAJOR 12″ £8·50



30-14,500 c/s, 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s Rated 20 watts. NOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30-17,000 c/s with tweeter, crossover, baffle and instructions. **£10·95**

Please state 3 or 8 or 15 ohms.

BAKER "BIG SOUND" SPEAKERS

Robustly constructed to stand up to long periods of electronic power. As used by leading groups. Useful response 30-13,000 cps. Bass Resonance 55 cps.

GROUP "25" 12in 25 watt 3, 8 or 15 ohms. **£7·75**

GROUP "35" 12in 35 watt 3, 8 or 15 ohms. **£8·50**

GROUP "50" 15in. 50 watt 8 or 15 ohms. **£17·80**

50 watt 12in VERSION £12·95

MAJOR 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER

All purpose transistorised. Ideal for Groups, Disco and P.A. 4 inputs speech and music. 4 way mixing. Output 8/15 ohm a.c. Mains. Separate treble and bass controls. Guaranteed. Details S.A.E. **£49** Carr. £1·00

NEW MODEL MAJOR 50 WATT

4 inputs, 2 way mixing, £39·95. Carr. £1. Ideal disco amp.

CALLERS ONLY! DE-LUXE 100 WATT AMPLIFIER CHASSIS. 7 Valve version, 4 inputs, 10 wide range controls. For Mikes, Discos, Organs, Guitars, etc. 4, 8 and 15 ohm Loudspeaker matching. **£69**

QUALITY LOUDSPEAKER ENCLOSURE

Teak veneered ¾in thick wood cabinet. Size 18½in × 18½in × 8½in. Weight 23lbs. This cabinet features a wide mesh Silver Grill covering a separate compartment for mounting Tweeters or Mid-Range Horn. The fully sealed bass compartment is cut out for 6½in Woofer. £7.50. Carr. 85p. Rosewood Version £8·50. Carr. 85p.

Baffle could be cut for larger speaker.

SPECIAL OFFER 95p. Post 25p.

100 Ohm 20 watt Rheostat 2½in dia. Ceramic Former. Screw Terminals ¼in. dia. spindle.

R.C.S. STEREO DECODER

British made. Ready aligned and tested. Complete with instructions. Size 3in × 2in. **£4·95**

WEYRAD COILS

P50/2CC	40p	RA2W	85p
P50/1AC	60p	OPT1	65p
P50/3CC	40p	LFDT4	65p
PCA1	85p	Twin gang	£1·20

DELUXE 4 POLE MOTOR

1,400 r.p.m. reversible 42 Watt, spindle 1¼in × 7/32in, size 3½in × 3in. As illustrated. 240V a.c. mains. **£2·25** Post 25p

E.M.I. GRAM MOTOR

120V or 240V a.c. 2,400 rpm. 2-pole 70mA. Size 2⅞ × 2¼ × 2¼in. **£1·00** Post 25p

BAKER HI-FI SPEAKERS
HIGH QUALITY—BRITISH MADE

REGENT
12in. 15 watts

An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio, Amplifier, Hi-Fi or Television receiver.

Bass Resonance	45cps
Flux Density	12,000 gauss
Useful response	45-13,000cps

3 or 8 or 15 ohm models.

£7·75

DE-LUXE Mk II
12in. 15 watts

Especially designed to provide full range reproduction at an economical cost. Suitable for use with any high fidelity system. Built-in concentric tweeter cone.

Bass Resonance	30cps
Flux Density	14,000 gauss
Useful response	25-16,000cps

8 or 15 ohms models.

£9·75

SUPERB
12in. 20 watts

A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.

Bass Resonance	25cps
Flux Density	16,500 gauss
Useful response	20-17,000cps

8 or 15 ohms models.

£13·80

AUDITORIUM
12in. 25 watts

A full range reproducer for high power, Electric Guitars, public address, multi-speaker systems, electric organs, Ideal for Hi-Fi and Discotheques.

Bass Resonance	35cps
Flux Density	15,000 gauss
Useful response	25-16,000cps

8 or 15 ohms models.

£12·95

AUDITORIUM
15in 35 watts

A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discotheques, Electronic instruments and the home Hi-Fi.

Bass Resonance	35cps
Flux Density	15,000 gauss
Useful response	20-14,000cps

8 or 15 ohms models.

£17·80

Hi-Fi Enclosure Manual containing plans, designs, crossover data and cubic tables. 63p.

CUSTOMERS FREE CAR PARK

OPEN 9-6 p.m. WEDNESDAYS 9-1 p.m., SATURDAYS 9-5 p.m. (Closed for Lunch 1.15-2.30)

SPECIALISTS

337 WHITEHORSE ROAD · CROYDON

(Export: Remit cash and extra postage.)

Buses 50, 68, 159. Rail Selhurst

Telephone 01-684-1665

New. Sinclair IC20. 20 watts stereo amplifier kit for only £7.95 (plus VAT)

A build-it-yourself stereo power amplifier with latest integrated circuitry... 10 W RMS per channel output... full short-circuit and overheat protection.

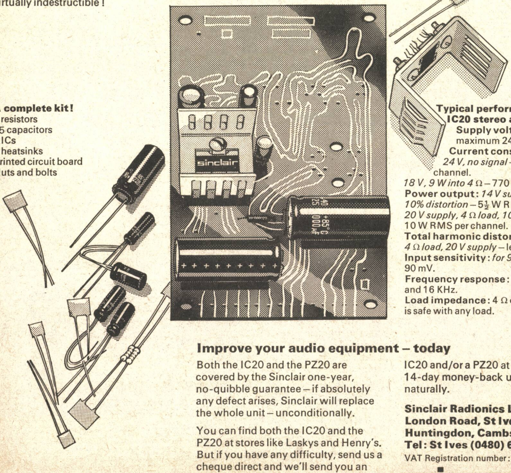
Latest from Sinclair – the brand new IC20 power amp. It incorporates state-of-the-art integrated circuits – 2 monolithic silicon chips each containing the equivalent of over 20 transistors ! These deliver 10 W per channel into 4 Ω speakers. And the IC20 has integral short-circuit protection and thermal cut-out – it's virtually indestructible !

How should I use the IC20?

Use the IC20 for converting your mono record player to stereo . . . for upgrading your existing stereo . . . for improving your car radio/tape player. The IC20 runs off a 9-24 V power supply. If you're running the IC20 off the mains, simply add a Sinclair PZ20 power supply (£4.95 plus VAT).

Using the IC20 to improve your car radio/tape player's quality and volume ? Run the IC20 off the car battery direct. You don't need a separate power supply, and you're reducing the drain on the player's dry batteries.

A complete kit!
6 resistors
15 capacitors
2 ICs
2 heatsinks
Printed circuit board
Nuts and bolts



Typical performance of the IC20 stereo amplifier

Supply voltage: absolute maximum 24 V, minimum 6 V.
Current consumption: *24 V, no signal* – 20 mA each channel.
18 V, 9 W into 4 Ω – 770 mA each channel.
Power output: *14 V supply, 4 Ω load, 10% distortion* – 5½ W RMS per channel, *20 V supply, 4 Ω load, 10% distortion* – 10 W RMS per channel.
Total harmonic distortion: at *50 mW, 4 Ω load, 20 V supply* – less than 0.1%.
Input sensitivity: *for 9 W into 4 Ω* – 90 mV.
Frequency response: – 3 dB at 40 Hz and 16 KHz.
Load impedance: 4 Ω or 8 Ω, but device is safe with any load.

Improve your audio equipment – today

Both the IC20 and the PZ20 are covered by the Sinclair one-year, no-quibble guarantee – if absolutely any defect arises, Sinclair will replace the whole unit – unconditionally.

You can find both the IC20 and the PZ20 at stores like Laskys and Henry's. But if you have any difficulty, send us a cheque direct and we'll send you an IC20 and/or a PZ20 at once. 14-day money-back undertaking, naturally.

Sinclair Radionics Ltd,
London Road, St Ives,
Huntingdon, Cambs., PE17 4HJ.
Tel: St Ives (0480) 64646
VAT Registration number: 213 8170 88.

sinclair

PE

DISCORDANT VOICES

All is not harmonious in the musical world, as students of electronics are likely to be well aware. Opinion among musicians is certainly found to be sharply divided when the involvement of electronic techniques is discussed. Is there any real danger that traditional musical styles will suffer, or even be swept away, in the future by the new sounds and tonal expressions electronics alone is capable of producing? Fears of such an impending catastrophe are sometimes expressed by the more conservative minded.

The technology of electronics and the art of music have long been intermeshed one with the other. As a sound reinforcing agency, electronics has an extremely long association with traditional music and instruments. But ever since the infinite capabilities of tone pattern generation became recognised by circuit designers, innovation in sounds has become as important, and even more exciting, a role for electronics in the music field. From then on, it seems, a dilemma emerged. For some at any rate. Which is the right road for music-electronics to pursue: using electronic techniques to imitate or to reinforce without altering the essential character of traditional instrument sounds; or using electronic circuitry freely without limitations to create sounds that are original or, at least, do not have to be considered mere imitations of the voicing of acoustical instruments.

Undeniably there are two distinct paths; but each is clearly signposted. Both obviously have important parts to play in the development of the musical art and its wider appreciation. But the territory between these two well defined paths has become rather mudded and some state of confusion has been created in the minds of certain travellers who have become bogged down in this ill-defined area. So arguments and protests have arisen from upholders of the pure traditional approach to music, with counter arguments from the protagonists of uninhibited exploitation of electronic means and ends in the whole area of music, from composition to performance.

The non-specialist in musical affairs can leave the finer points of the debate to those who are academically or commercially involved in the musical arts. Sufficient to say electronics is a ready and willing servant of unquestionable value always at the disposal of the guardians of the muse, whensover they make the call.

A good concrete example of the first line of approach as mentioned above is the electronic piano, where electronic techniques are employed to imitate a classical type of musical instrument. The great advantage over the conventional piano is less bulk and weight. Factors of considerable importance in the modern home. In regard to performance electronics is here paying the conventional instrument a compliment, since modern circuit techniques are applied to the task of simulating as closely as possible the characteristics of a normal piano. Though extra voicing facilities are incorporated in the case of the PE Joanna as a bonus. A small electronic indulgence which should not offend even the purists among piano players.

F.E.B.

Editor
F. E. BENNETT

Editorial
R. D. RAILTON *Assistant Editor*
D. BARRINGTON *Production Editor*
G. GODBOLD *Technical Editor*

Art Dept.
J. D. POUNTNEY *Art Editor*
R. J. GOODMAN
K. A. WOODRUFF

Advertisement Manager
D. W. B. TILLEARD
Phone: 01-634 4202

P. J. MEW
Phone: 01-634 4210

C. R. BROWN, *Classified*
Phone: 01-634 4301

Editorial & Advertising Offices:
Fleetway House, Farringdon St.
London EC4A 4AD
Phone: *Editorial* 01-634 4452
Advertisements 01-634 4202

A new generation electronic piano with an exciting specification

- **High degree of piano tone simulation**
- **Fully touch sensitive keyboard**
- **Alternative voicing of Honky-Tonk and Harpsichord**
- **Simple tuning with a high degree of accuracy**
- **Soft and sustain pedals**
- **Lightweight, attractive styling with amplifier incorporated in stool**
- **Cost to build £120 approx.**

PE JOANNA

By A.J. BOOTHMAN B.Sc.

CONVENTIONAL

HARPSICHORD

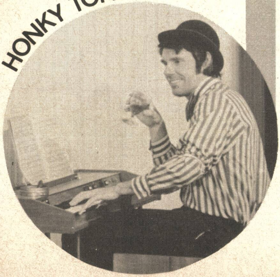
SINCE the first publication of an electronic piano design, which was in PRACTICAL ELECTRONICS over the period September 1972 to January 1973, the instrument has been the subject of a sharp increase in popularity. A number of commercial versions have become available on the market, whilst many organ manufacturers now include a piano stop on a large part of their range. Many of the types on offer are not touch sensitive, which, although being an advantage when used in conjunction with an organ, is a distinct drawback when a full piano substitute is required. Other designs have questionable tone or voicing which can soon become unacceptable. The P.E. Electronic Piano had a very small degree of touch sensitivity and a basic functional tone, and has now grown into the "Joanna" which combines a very wide range of touch with a good piano tone, whilst achieving a further decrease in size. In addition to its ideal adoption as the family instrument this therefore makes it very convenient to sit on top of an organ as an extra manual with or without touch sensitivity.

In establishing the new design the standard piano was investigated in more detail and the following facts and comments will be of interest to the reader.

PIANO HISTORY

According to past literature on the subject the first stage in the evolution of the piano was the clavichord, which used the impact of metal blades on horizontally stretched wires. The other notable predecessor was the harpsichord in which a mechanically coupled plectrum was used to pluck the strings. Instruments of the latter type can still be obtained, and in the "Joanna" a harpsichord tabswitch is provided.

The pianoforte, in which the wire is struck by a felt covered wooden hammer which is allowed to quickly fall back, has evolved into two basic types, namely the grand and the upright. The latter, which is of course the most common type, covers a wide range of tonal qualities, many of which have their


HONKY TONK

P.E. PIANO SPECIFICATION

MUSICAL COMPASS

Five Octaves C to C 61 Notes

FREQUENCY COMPASS

Fundamental Frequency Range	60Hz to 2kHz approx
Master Oscillator	500kHz approx

NOMINAL OUTPUT LEVELS

External Amplifier	1V into 1MΩ 400mV into 10kΩ 100mV into 2kΩ
Headphones	50mW into 4Ω

TOUCH CHARACTERISTICS

Dynamic Range	>27dB
Key Action	<1oz

MAINS INPUT

240 Volts 50 Watts

SOUND ENVELOPE (nominal times)

Touch Range	2 to 40mS
Attack Period	<1mS
Early Decay	500mS
Sustain Period	3 to 5S (varies over compass)

TREMOLO FREQUENCY (nominal)

Slow	5Hz
Fast	10Hz

DIMENSIONS AND WEIGHT

Case	38in × 14in × 5in
Height of legs	24in
Weight	20lbs

CONTROLS

Level Control/On–Off Switch
Piano Tab
Honky-Tonk Tab
Harpsichord Tab
Tremolo Slow Tab
Tremolo Fast Tab
Sustain Foot Pedal
Soft Foot Pedal

SOCKETS

Mains Supply Socket
Pedal Socket
External Amplifier Socket
Headphone Socket
Stool Amplifier

POWER

Output Power 15–25 Watts

own individual appeal. Apart from the rich full piano sound obtainable from a high quality instrument, the other most characteristic variation, which is usually associated with age, is the honky-tonk. The "Joanna" provides a honky-tonk tabswitch, and by using all three tabs in combination a wide range of tone is available to the performer.

COMPASS AND SIZE

A normal piano covers 7¼ octaves, with some smaller versions having a limited availability. The stringing of the piano is necessarily complex and takes up a considerable amount of space, fold-over techniques being used to minimise the volume where possible. Limiting the compass to five octaves greatly assists in reducing the size of the electronic instrument to minute proportions when compared with the conventional instrument, and is convenient from the electronic component point of view in simple economic tone generation. The choice of compass is an individual matter, but the author now prefers to use C-C in the general home environment, whereas F-F has been used for group work. In order to give some compensation for the loss of bass notes it has been simple to arrange for a slight enhancement of the level of the bottom two octaves, and the result has been assessed to be a good compromise by a number of pianists with widely differing styles.

TOUCH ACTION

The keyboard dynamic range of a piano is in the range 50–60dB, but this level of touch sensitivity is not often available in the average instrument, and the 30dB or so offered by the "Joanna" should be pleasing to most pianists. The principle of touch action is the subject of much discussion but suffice it to say that the majority opinion is that the final hammer velocity is the only determining factor in the resulting sound. In the conventional piano the velocity defines the level of output and the tonal quality, and the means by which this velocity is achieved, e.g. a gradual build up of key speed, effects neither parameter.

In the "Joanna" the level of output is varied by the average speed of the key over the depression period, and the tone is not altered, other than through the normal effect in the ear of the listener where perceived tone varies with level. The level control is used to limit the maximum volume achievable to suit the environment and is not operated during the execution of a musical score. The final aspect of touch is the key-weight which is considerably less than the normal 2oz. This gives a very fast action, but does of course feel different to a normal piano keyboard, and requires time to become adjusted.

ENVELOPE

Many resonance effects are present in a piano which result in a complex decay portion of the envelope, both in terms of level and harmonic content. A large influencing factor is the use of multiple stringing and the way in which sympathetic resonances can be initiated by the note being struck. Simulation of these effects could be achieved by extensive electronic synthesis, but to produce a polyphonic instrument by such techniques is outside the economic scope of the large area of interested constructors who are also prepared to accept that a full detailed synthesis of a piano is not of the utmost importance, whilst an improvement on presently available designs is welcome. The "Joanna" offers a decay characteristic which varies in length across the compass, and is in the region of five to three seconds.

Control switches and voicing tabs

VOICING

Two tonal aspects are mentioned above where simulation is not attempted, i.e. variation of the harmonics content with key velocity and over the decay period. The harmonic content of the basic note differs over the range of the board, and the voicing circuits are designed to give a greater level of high harmonics at the lower end of the piano to match the conventional instrument. The voicing circuits allow the constructor some freedom of fine adjustment to suit his own taste, and are split into three groupings across the keyboard.

PEDAL ACTION

The soft pedal of a grand piano operates the hammer action mechanism to move it into a position whereby the number of strings hit on the multi string sections is reduced, whereas the upright system is to reduce the hammer travel and thus its terminal velocity. The "Joanna" by simultaneously reducing the output level from all notes is similar to the upright action. The sustain pedal raises all dampers, and is directly simulated in the electronic version.

ENVIRONMENTAL ACOUSTICS

As with all sound sources, the acoustics of the environment can have a very great effect on the overall result obtained from a piano. The first noticeable effect is the difference in tone experienced at varying distances from the sound source which occurs with both the conventional and electronic piano. The second is the way in which the size of the room influences the bass response of the instrument.

Reverberation can enhance the piano tone considerably as would be experienced by comparing the result on a high quality piano in the average living room, with the same instrument located in a concert hall. The "Joanna" can easily be fed into a spring line reverberation unit, which if used to a very small degree can give a pleasing sound in a small room. Headphones can be plugged into the instrument for silent practice, or to create your own sound stage without any influence from the room environment.

TUNING

The conventional piano requires tuning at least once a year, and is often left considerably longer. The use of the master tone generator in the "Joanna" ensures that the relative tuning of all notes is extremely accurate and not subject to variation. Compared with some two hundred tuning adjustments on the normal piano, the "Joanna" has only one.

COST

As stated earlier it is not beyond the reach of electronics to completely synthesise the action and sound of a piano, but the value of attempting such a project is extremely questionable. We are not going to see a concert pianist changing to an electronic piano for major performances and the project should be judged against the background of the average domestic upright, taking up considerable room space and having a present day cost of at least £400. For an outlay of approximately £120, depending on the amount of effort which the constructor wishes to apply, an attractive practical instrument can be provided for the use of all the family which will give many hours of pleasure.

OVERALL SYSTEM

The block diagram Fig 1.1 shows the way in which the various sub-units are interconnected to make up the "Joanna" and from the diagram the overall principles of operation can be understood.

The keyswitch assembly, linked to the five octave keyboard, consists of 61 single pole changeover switches, operating between ground potential when at rest and a rail voltage of approximately 20 volts when the key is depressed. Touch resistors are mounted on the keyswitch assembly as indicated.

The switch outputs are routed to 12 boards, each containing five envelope circuits, such that all octaves of one semitone go to one board. Three outputs are taken from the Envelope Boards, grouping the bottom two octaves, the middle two octaves, and the top octave, and lead to the Preamplifier Board. This contains separate voice filters for each of the groupings mentioned, feeding to a preamplifier the gain of which is determined by a voltage controlled amplifier in the feedback loop. The latter has both tremolo and soft pedal control inputs. A direct output is taken from the preamplifier for

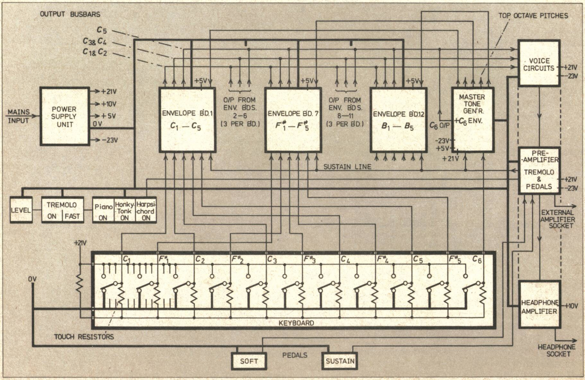


Fig. 1.1. Block diagram of the "Joanna"

Bulk Component List

To take advantage of any concessions offered by retailers for bulk purchases the following quantity list is included.

Individual component lists will appear as usual with circuit diagram as they occur.

Integrated Circuits

ZN7404	2
ZN7472	1
ZN7493	12
μA741 (8-pin d.i.l.)	5
MFC6040	1
MFC4000	1
μA7805	1
AY-1-0212	1

Transistors

ZTX108	77
ZTX501	1

Diodes

Cheap silicon diodes (e.g. 1S44, OA200 types)	20 volts	183

Capacitors

4·7μF Electrolytic 25Vmin	61
4·7μF Electrolytic 12Vmin	61

Resistors

56Ω	61	120kΩ	122	270kΩ	12
2·2kΩ	12	150kΩ	50	330kΩ	12
33kΩ	61	180kΩ	24		
47kΩ	170	220kΩ	26		

All $\frac{1}{3}$ watt carbon 5% tolerance

The above list includes all semiconductors, 80% of the resistors, and approximately 50% of the capacitors

use with an external power amplifier and a low power output stage is included to drive headphones when required. The Preamplifier Board also contains a sustain pedal circuit, the output of which is linked to the Envelope Boards.

Generation of the 12 semitones in the top octave is carried out by one integrated circuit fed by a 500kHz input frequency. This is mounted on the Master Tone Board which also carries the envelope circuit for the top note of the piano. The dividers for the lower four octaves are included on the Envelope Boards.

The voice switching is performed between the voice circuits and the preamplifier. The use of a single tab gives the pure sound for that instrument, whilst more than one tab can be used simultaneously in order to provide tonal variations to suit the performer. The tremolo switching offers two speeds of tremolo as required.

PIANO ACTION

The fundamental piano action is obtained from the envelope shapers which are shown in block form in Fig 1.2.

The time taken for the keyswitch to travel between the two busbars is converted by the touch sensor into a reducing voltage which is passed onto the sustain storage circuit as a fast leading edge to the envelope. The early decay circuit emphasises the percussive nature of the sound, and the damper operates in the normal piano manner, where it can be overidden by the sustain pedal. The resulting envelope is shown in Fig 1.3.

The final decay is obtained from the loading of the chopper on the sustain storage circuit. The chopper is fed from the divider circuits and feeds an output to the signal busbars.

INTEGRATED CIRCUITS

It can easily be envisaged that an electronic piano is an ideal equipment for total integration, and this will be achieved when a special i.c. is designed for the envelope circuit. At present it would seem that different circuits, in discrete form, are used by each

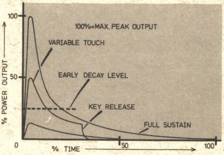


Fig. 1.3. Envelope shapes

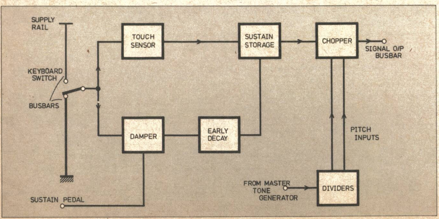
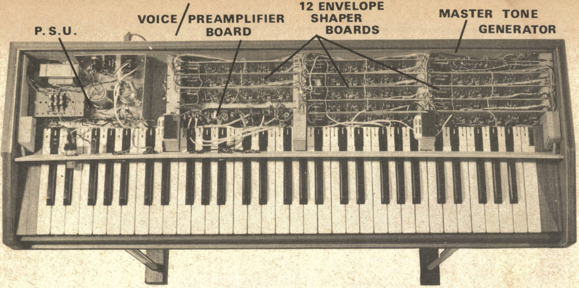


Fig. 1.2. Block diagram of envelope shapers. 61 are required



Interior of piano showing location of sub-assemblies

manufacturer of commercial equipment, but eventually one configuration would be expected to dominate, and the design of a hex or quintuple envelope i.c. will emerge. The "Joanna" uses i.c.s for master tone generation, dividers, voice circuits, preamplifier, headphone amplifier, and power supply.

PHYSICAL CONSTRUCTION

The prototype was housed in a teak veneered cabinet, mounted on chromium plated tubular legs. The pedals are fixed to a similar tube which spans the supporting feet which are made of solid teak. Whilst this combination gives a very attractive finish, a cheaper cabinet could be produced using a mixture of ordinary chipboard and blockboard, covered in a heavy vinyl material, which would also be more suitable if portability is required.

All the controls, except for the pitch adjustment, are mounted on the narrow strip immediately above the keyboard, in an easy playing position. The pitch control is revealed by removal of the music stand and lid.

Referring to the photograph of the interior details, the Power Supply is built on its own separate chassis, whilst the cabinet is designed to provide natural support for all the printed boards. Plug in connectors have not been used, in order to keep the cost to the minimum. The socket panel, sunk into the rear of the instrument, provides external amplifier, and headphone outputs, mains and pedal inputs, and carries the mains fuse. The keyboard is mounted directly to the base of the cabinet. This has the particular advantage, when used as an extra manual in an organ, of reducing the height between the keyboard and the top surface of the organ. The base of the cabinet is designed to give very easy access to the keyswitch assembly, without removal of the keyboard.

The piano stool has been designed to accommodate a power amplifier and 12in heavy duty loudspeaker. A mains socket has also been provided to give a neater appearance to the necessary interconnecting leads between piano, stool, and wall socket.

KEYBOARD AND KEYSWITCH

The "Joanna" cabinet design is based on the use of the five octave Kimber-Allen Swedish keyboard type S.K.A., and the Clef Products keyswitch type CPS 1027, which is specially designed for use with this keyboard. The high quality Kimber-Allen unit has been adopted due to its relatively low weight and high mechanical rigidity which also simplifies cabinet construction.

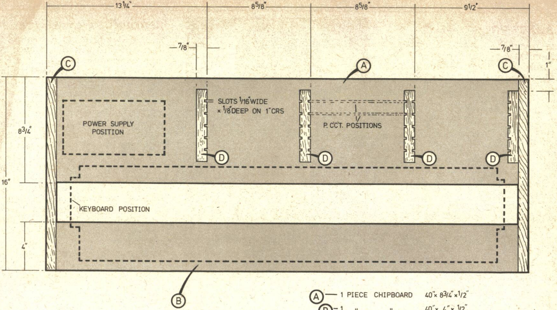
BUILDING SEQUENCE

The recommended sequence for construction is to commence by building a simple jig as shown in Fig. 1.4. This allows accurate construction of the final cabinet to be carried out in parallel with the electronic work, thus avoiding the delay associated with high standard woodwork and the possibility of damaging the cabinet during the testing of the sub-assemblies.

If finances allow the purchase of the keyboard and keyswitch at the start of the project, they can be mounted in the jig immediately and used later in testing out the envelope boards, but an alternative is to make a set of five single pole two-way switches as shown in Fig. 1.5, and mount them on the front base-panel of the jig. This will allow the testing of one Envelope Board at a time.

The first electronic units to build are the Power Supply and Tone Generator Board, which can be placed in their appropriate positions in the jig. Any power amplifier can be used to test the outputs from the Tone Generator Board, and the Socket panel can be used to give a permanent connection to the amplifier, with a test lead connected to the output socket via a 47kΩ resistor and a 0·5 μF capacitor. The next step will be to build the Envelope Boards, which after insertion into their allotted places in the jig can be tested using the experimental keys and the test lead described earlier.

The final board to construct will be the Preamplifier, which will then allow testing of the complete system to be carried out. At this point the tested system, including the Keyboard, can be transferred to the completed cabinet.



Ⓐ— 1 PIECE	CHIPBOARD	40"× 8¾"× ½"
Ⓑ— 1 "	"	40"× 4"× ½"
Ⓒ— 2 PIECES	TIMBER	16"× 1⅞"× ⅞"
Ⓓ— 4 "	"	6"× 1⅞"× ⅞"

Fig. 1.4. Simple jig for testing sub-assemblies

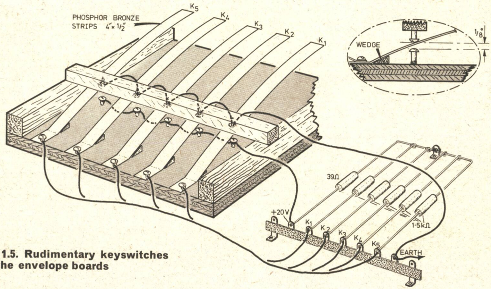


Fig. 1.5. Rudimentary keyswitches for the envelope boards

TEST/CONSTRUCTION JIG DETAILS

The base of the jig is split into two parts, the front part 4in wide, and the rear part 8¾in wide. This leaves a gap of 3¼in which is spanned by the keyboard. The two base panels are held together by timber end cheeks, screwing from underneath. Four p.c.b. supports are mounted on the rear base panel in the positions shown. Two of the supports require slots cutting on both sides.

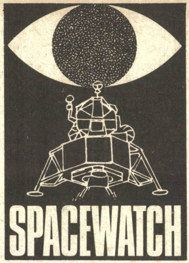
The Keyboard and Power Supply are fixed in the positions indicated. The p.s.u. chassis carries all plugs and sockets, and will provide the anchor point for the test lead. Four standard legs can be screwed onto the jig which produces a very useful work bench for the period of the project.

EXPERIMENTAL KEYS

If it is decided to leave purchase of the keyboard until later in the programme, the experimental key system shown in Fig. 1.5 can be constructed.

The five spring strips should be biased to press against the top screws, which are linked together and returned to ground potential. The five lower screws are also linked and returned to the supply voltage. In order to test the touch action the touch resistors should be wired as shown in the diagram.

Next month: Power Supply, Tone Generators and Envelope circuitry are described



SPACEWATCH

BY FRANK W. HYDE

1975 SPACE PROGRAMME

One of the most noticeable developments of the space era is that each year there is more and more international co-operation. The benefits of space science and earth applications from space activities. are becoming more widely recognised. This attitude is being reflected in the increasing number of launches.

The number of USA launches planned for 1975 was set at 25. Of these no less than 15 were to be from other countries or from international missions.

All the missions except one are unmanned. The manned mission is the joint USA and USSR *Apollo-Soyus* docking for which the training is almost complete. The Russian final field (space) trial took place in January with two astronauts living for 31 days in space. During this period they practised docking and moving from one vehicle to the other.

The link-up mission between the Russian and American astronauts is scheduled to take place on July 15. The crews will exchange visits and perform some scientific experiments. It is planned that the two spacecraft will be joined up for two days.

Altogether, there have been 25 joint planning meetings which began in 1972. In February the final arrangements were completed leaving only the final training of the crews. The final tests of the control communications between the two centres in Soviet Union and Houston has been successful.

Professor Bushuyev said at the last meeting that the *Soyus* spacecraft was fully prepared. Some special modifications have been made to the spacecraft in order that conditions may be more compatible. They have lowered the air pressure and raised the oxygen content. This brings the *Soyus* craft more in line with the system used by the USA.

Other modifications include the installation of new antennae and communication equipment together with flashing beacons, lights and an approach target which will assist the docking of the *Apollo* craft with *Soyus*.

The joint crews will have trained together and separately for five months before launch date. Some of this will take place in the USA and some in the USSR. The Russian crews, each of two men are, Commander Aleksey Leonov and Valeriy Dubasov the first crew with Anatliy Filipchenko and Nikolay Rukavishnikov of the second crew. The American team are Commander Thomas Stafford, Command Module Pilot Vance Brand, and Module Pilot Donald K. Slayton.

The joint mission of the USSR and the USA represents an important point in space history. The success of this mission will establish that it will be possible to affect rescue from space. Of course, it has always been possible to do this from the *Apollo* facilities but now the first steps in international facilities will be taken.

The ten day mission of *Apollo-Soyus* Test Project (ASTP) will commence with the launch from Baikonor, Kazakhstan on July 15. Some 7½ hours later a three man *Apollo* will be launched from the Kennedy Space Centre. Various activities will take place during which the crews will visit each other's quarters, and remain as one group for about two days. The *Soyus* spacecraft will then undock and return to Earth. The *Apollo* will remain in orbit six more days while the crew carry out some special scientific experiments.

OTHER MISSIONS

Of the remainder of the missions planned two are for the study of the Sun, nine for communications and navigation. Three are devoted to the study of the Earth's atmosphere and the environment and another four will study climate and air pollution. Two more are for astronomy and another for oceanographic research.

Twelve of the spacecraft to be launched by NASA are owned variousy by other nations or other government agencies and private agencies. These pay NASA for the launches. West Germany and France have the *Symphonie 2*. Two satellites are for *Intelsat*, the consortium of 80 nations. The European Space Research Organisation has one satellite for the study of cosmic rays.

RESOURCES SATELLITE

The second Earth Resources Satellite *ERTS 2* will it is hoped repeat the enormous success of *ERTS 1* which surpassed the most ambitious hopes of the planners. During the 29 months of activity prior to the launch of *ERTS 2* in January, the first of the satellites sent back more than 100,000 images covering the whole of the United States and most of the rest of the world.

The satellites are inter-nations in scope and mission. Any nation can obtain data taken over its own territory. The orbital time is 103 minutes with an observation band 115 miles wide. The data covers the observation of agriculture, forestry, marine resources and biology, water resources and air pollution. The data can be processed into images or other forms for computer assessment. These observations over any particular territory are repeated every 18 days.

The sensors on the *ERTS 2* are the same as those on *ERTS 1*. The return beam vidicon sub-system is a complement of three cameras sensitive to different regions of the electromagnetic spectrum. Full colour images can be constructed from the data, when each separate image is superimposed in its respective colour in a single frame. Every item found in nature reflects solar energy in a different way, often invisible to the naked eye, and this situation is overcome by the system used in the satellite. Thus desease of plants can be "seen" as well as many other changes.

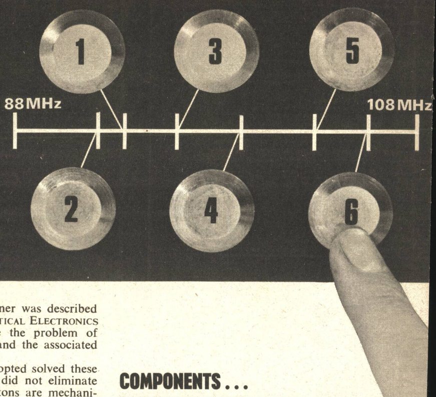
The multispectral scanner collects similar data by scanning the Earth directly below the satellite. Another, the data collector sub-system, collects and relays from some 1,000 ground based platforms located in remote areas. These platforms measure ground temperature, moisture content, winds and pressure and is correlated with the data recorded on the spacecraft.

THROUGH THE COMET'S TAIL

Comet Kahoutek revealed some of its secrets when the *Helios* satellite encountered space debris from the comet. Only a few particles were detected by the micrometeorite detector, but the implications are extensive.

The team responsible for the data suggest that the second *Helios* probe should be held back so that it can intercept Comet Encke which is due to return to our vicinity in 1977. This could have important consequences with regard to the theory of comet construction. Most workers lean toward the theory that conglomerate and icy particles fit the data so far available.

TOUCH TUNING UNIT



By R. J. BONFIELD

A PUSHBUTTON varicap stereo tuner was described in the May 1973 issue of PRACTICAL ELECTRONICS which was designed to overcome the problem of the mechanical tuning capacitors and the associated pulleys and pointers.

The pushbutton arrangement adopted solved these problems to a certain extent, but did not eliminate them altogether since the pushbuttons are mechanical devices. The requirement is a completely electronic method of tuning, namely a system of touch-operated switches, as is to be described.

PRINCIPLE OF OPERATION

When the base of any one of the Darlington pairs (Fig. 1) is touched a minute current will flow which is amplified. This current causes the voltage on the corresponding collector line to drop, and one of the flip-flops in IC1 will switch on. As the i.c. contains six flip-flops, six pre-tuned stations are available.

To ensure that only one station is selected at any one time, diodes D1–D6 reset all the flip-flops when any one is selected.

The voltage at the output of the selected flip-flop will rise to 7V and appear across the preset potentiometer used for tuning. This voltage is not sufficient for most varicap tuners, so it is amplified by the operational amplifier IC2.

L.E.D. DISPLAY

The circuit of the l.e.d. station readout is shown in Fig. 2. The 7-segment l.e.d. displays a station from 1 to 6. When the unit is initially switched on,

Table 1: Allocation of stations

Touch Button	Station Selected
1	BBC local radio (Radio London)
2	BBC Radio Two
3	BBC Radio Three
4	BBC Radio Four
5 6	Alternative IBA or BBC local radio stations

COMPONENTS . . .

Resistors

R1–R6	10kΩ (6 off)
R7	470Ω
R8–R9–R10	(see Table 2)
R11	82kΩ
R12	100kΩ
R13–R15	1kΩ (3 off)
R16	(see Table 2)
R17–R24	150Ω (8 off)

All 10%, ½W carbon except where otherwise stated

Capacitors

C1	680μF elect. 16V
C2	10μF elect. 16V
C3	2,200μF elect. 6·3V
C4	0·1μF polyester
C5	1μF elect. 16V
C6	10μF elect. 16V
C7	1μF elect. 16V

Potentiometers

VR1–VR6 10kΩ trimpots or skeleton presets

Diodes

D1–D6	IN914 or OA200 (6 off)
D7	(see Table 2)
D8	BZY88 C6V8 6·8V 400mW Zener
D9–D16	IN914 or OA200 (8 off)
D17	BZY88 C5V1 5·1V 400mW Zener
D18–D26	IN914 or OA200 (6 off)
D27	BZY88 C5V1 5·1V 400mW Zener

Transistors

TR1–TR12 BC109C (12 off)

Integrated Circuits

IC1	SN74118N
IC2	741C
IC3	SN7447A
IC4	DL709 (Bywood Electronics)

Miscellaneous

Pegboard, Veropins, wire, 8 and 16 pin i.c. sockets, six metal buttons

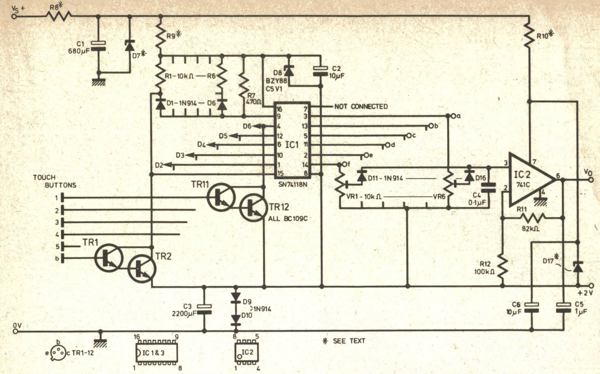


Fig. 1. Circuit diagram of basic Touch Tuner. Note the inclusion of the large electrolytics C1 and C3. These are for ripple suppression if a stabilised mains supply is used

the figure "0" appears until a station is selected. The user must remember which station corresponds to each number.

A suggested method of station identification is shown in Table 1. A similar table could be printed on the front of the tuner using Letraset, or similar transfers.

VOLTAGE STABILISATION

If the supply voltage is derived from the mains it is essential that stabilisation is included. To adapt to various supply voltages as shown in Table 2, the requisite component changes are given. Total power requirement is about 5W.

Table 2: Changes for various supplies

V_S	R8	R9	R10	R16	D7 BZY88-	D17 BZY88-
35	200Ω (2W)	82Ω	560Ω	220Ω (5W)	C15V	C6V8
24	82Ω (2W)	82Ω	560Ω	120Ω (5W)	C15V	C6V8
15	27Ω (½W)	47Ω	270Ω	33Ω (1W)	C12V	C6V8
12	—	47Ω	270Ω	33Ω (1W)	—	C6V8
9	—	22Ω	—	15Ω (½W)	—	—

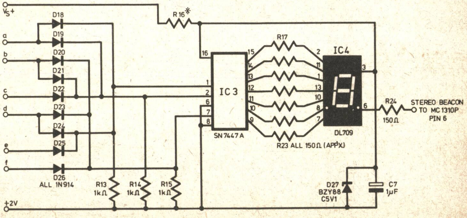
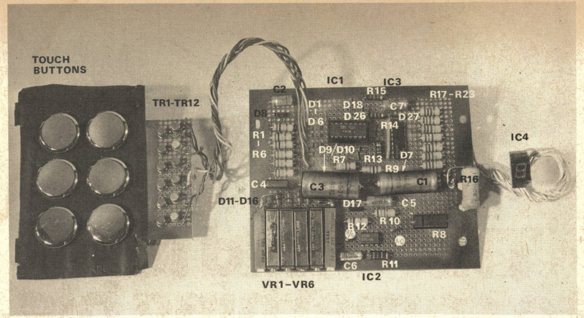


Fig. 2. Circuit for decoder and readout



Component layout for Touch Tuner. Keep lead lengths from transistor board short. Other layouts can be attempted on Veroboard or p.c.b. if so desired

COMPONENTS

Diodes D1 to D6, D11 to D16 and D18 to D26 can be any silicon types. The six preset potentiometers are ideally trimpots for ease of tuning, although carbon skeleton types may be used. In this case it may be desirable to add padding resistors between each preset and IC1, the value of these resistors may be in the range 4·7kΩ to 27kΩ depending on the tuning spread required.

The values of R8, R9, R10 and the voltages of Zeners D7 and D17 should be selected from Table 2. Where they are not required, resistors must be replaced by short-circuits and diodes by open circuits.

Resistor R16 will become hot when a high supply voltage, i.e. 24V or 35V, is used. In these cases it must be a 5W component and must be mounted where it will not damage other components, preferably off the main circuit board.

The decimal point on the 7-segment display can be employed as the stereo beacon, by connection to pin 6 of the MC1310 stereo decoder i.c.

The l.e.d. may be glued to the rear of the tuner's front chassis, behind a rectangular hole. Connections would then be made by wires several inches long from the circuit board to an i.c. socket which is plugged onto the l.e.d.

The pin numbers shown in Fig. 2 for the l.e.d. apply to the Hewlett Packard 5082-7730 or the Data Lit 707. Other types, such as the DL747, can be used, but the pin connections must be checked. IC3 is the 7-segment decoder.

CONSTRUCTION

It is recommended that i.c. sockets are used, in particular for IC1 and IC3. The input transistors must be mounted close to the touch buttons on a separate board, as shown in the photograph. *It is important that the touch buttons are not connected to the transistors by long leads.*

The preset potentiometers should be mounted away from the circuit board, in a position convenient for adjustment. If the maximum output voltage is too low, it can be increased by changing R12 to 120kΩ or 270kΩ.

In the prototype, six metal buttons were Araldited to Bakelite, otherwise any small metal objects are suitable.

TESTING

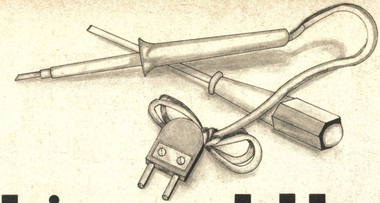
To test the unit connect V_s and 0V to any one of the recommended power supplies given in Table 2, making sure that the appropriate component amendments are made.

Connect the output, V_0, to pin C of the LP1186 tuner module. It is not necessary to make a connection between the touch circuit and pin E of the LP1186. Check that R17 is connected if it is external to the board and check the connections to the 7-segment l.e.d. if fitted.

Turn each preset to its lowest voltage position and switch on. The l.e.d. should read "0". Touch each panel in turn and the readout should change each time. If this is not so, check the connections to IC1. If incorrect segments are illuminated, check diodes D18 to D26 and the l.e.d. connections.

Locate the preset for the selected station. The voltage across this potentiometer should be 4V to 5V. The output should be 1·5V to 2V. Rotate the potentiometer to its maximum position and the output should be 8V to 10V. Check these voltages with a voltmeter.

As the preset is rotated from its minimum position, the first station to be tuned in should be Radio 2. If it is Radio 3 or Radio 4, and Radio 2 cannot be tuned in, then the voltage across D9 and D10 is too high, so one of these diodes should be removed or replaced. If no stations can be tuned in, and the voltage across D9 and D10 is less than 1·5V, check whether one of the diodes is faulty and if so replace it, otherwise add a third diode in series with the first two. ★



This could lead to something big.

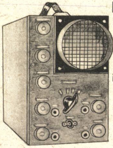
A soldering iron and a screw driver. If you know how to use them, or at least know one end from the other, you know enough to enrol in our unique home electronics course.

This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

You build, see and learn as, step by step, we take you through all the fundamentals of electronics and show you how easily the subject can be mastered and add a new dimension not only to your hobby but also to your earning capacity.

This course is accepted by and used in a large number of schools and colleges and forms an invaluable grounding for professional training in the subject. All the training is planned to be carried out in the comfort of your own home and work in your own time. You send them in when you are ready and not before. These culminate in a final test and a certificate of success.

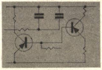
1



Build an oscilloscope.

As the first stage of your training, you actually build your own Cathode ray oscilloscope! This is no toy, but a professional test instrument that you will need not only for the course's practical experiments, but also later if you decide to develop your knowledge and enter the profession. It remains your property and represents a very large saving over buying a similar piece of essential equipment.

2



Read, draw and understand circuit diagrams.

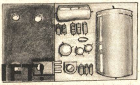
In a short time you will be able to read and draw circuit diagrams, understand the very fundamentals of television, radio, computers and countless other electronic devices and their servicing procedures.

3

Carry out over 40 experiments on basic circuits.

We show you how to conduct experiments on a wide variety of different circuits and turn the information gained into a working knowledge of testing, servicing and maintaining all types of electronic equipment, radio, t.v. etc.

PLUS



FREE GIFT!

ALL STUDENTS ENROLLING IN OUR COURSES RECEIVE A FREE CIRCUIT BOARD ORIGINATING FROM A COMPUTER AND CONTAINING MANY DIFFERENT COMPONENTS THAT CAN BE USED IN EXPERIMENTS AND PROVIDE AN EXCELLENT EXAMPLE OF CURRENT ELECTRONIC PRACTICE

To find out more about how to learn electronics in a new, exciting and absorbing way, just clip the coupon for a free colour brochure and full details of enrolment.

WAA

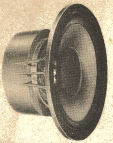
Brochure without obligation to:
BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL, Dept. EL55
P.O. Box 156, Jersey, Channel Islands.

NAME ....

ADDRESS ....

....

(Block caps please)



WILMSLOW AUDIO

THE Firm for speakers!

SPEAKERS

Baker Group 25 3, 8 or 15 ohm	£7·75
Baker Group 35 3, 8 or 15 ohm	£8·50
Baker Group 50/12 8 or 15 ohm	£12·50
Baker Deluxe 12in d/cone	£10·75
Baker Major 12in d/cone	£8·50
Baker Regent	£7·75
Baker Superb	£14·50
Baker Auditorium 12	£12·50
Celestion MH1000, 8 or 15 ohm	£10·95
Celestion PS8 for Unilex	£3·25
Celestion G12M 8 or 15 ohm	£12·00
Celestion G12H 8 or 15 ohm	£15·00
Celestion G15C 8 or 15 ohm	£24·00
Celestion G18C 8 or 15 ohm	£33·00
Coral 6½in d/cone roll surr. 8 ohm	£2·50
Coral 8in d/cone roll surr. 8 ohm	£3·25
EMI 13in × 8in 3, 8 or 15 ohm	£2·25
EMI 13in × 8in 150 d/c 8 ohm	£2·50
EMI 13in × 8in 450 t/tw. 3, 8 or 15 ohm	£3·75
EMI 13in × 8in type 350 8 or 15 ohm	£8·25
EMI 13in × 8in 20W bass	£6·60
EMI 6½in 93850 4 or 8 ohm	£3·00
EMI 5in 14A/7030 mid range 8 ohm	£2·50
EMI 8 × 5 d/cone, roll surr. 10W	£2·50
EMI 2½in tweeter 97492AT	£0·65
Eagle DT33 30W tweeter	£5·45
Eagle HT15 horn tweeter	£3·80
Eagle CT5 cone tweeter	£1·75
Eagle CT10 tweeter 8 or 16 ohm	£2·55
Eagle MHT10 horn tweeter	£3·80
Eagle crossover CN23, CN28, CN216	£1·50
Eagle FR4	£5·30
Eagle FR65	£8·35
Eagle FR8	£10·65
Elac 9 × 5 59RM109 15 ohm, 59RM114 8 ohm	£2·80
Elac 6½in 6RM171 d/c roll surr.	£3·50
Elac 6½in 6RM220 d/cone	£2·65
Elac 4in tweeter TW4	£1·50
Elac 10in d/cone 10RM239 8 ohm	£2·65
Elac 8in 8CS175 3 ohm	£2·50
Fane Pop 15W 12in	£5·25
Fane Pop 25T 30W 12in	£7·25
Fane Pop 50W 12in	£12·00
Fane Pop 55 60W 12in	£12·50
Fane Pop 60W 15in	£13·25
Fane Pop 100W 18in	£24·50
Fane Crescendo 12A 100W 12in	£29·00
Fane Crescendo 12B bass	£29·00
Fane Crescendo 15in 100W	£36·00
Fane Crescendo 18in 150W	£51·95
Fane 801T 8in d/c roll surr.	£7·00
Fane 807T 8in d/c roll surr.	£3·85
Fane 808T 8in d/c	£2·75
Fane 701 twin ribbon horn	£35·00
Fane 910 horn	£12·75
Fane 920 horn	£33·00
Goodmans 8P or 15 ohm	£5·00
Goodmans 10P 8 or 15 ohm	£5·30
Goodmans 12P 8 or 15 ohm	£12·95
Goodmans 12P-D 8 or 15 ohm	£16·75
Goodmans 12P-G 8 or 15 ohm	£15·75
Goodmans Audiomax 12AX 100W	£36·50
Goodmans Audiomax 15AX	£40·25
Goodmans 15P 8 or 15 ohm	£21·00
Goodmans 18P 8 or 15 ohm	£36·00
Goodmans Hifax 750	£16·00
Goodmans Axent 100 tweeter	£7·25
Goodmans Audiom 100 12in	£7·25
Goodmans Axiom 402 12in	£17·25
Goodmans Twinaxiom 8	£8·25
Goodmans Twinaxiom 10	£9·00
Kef 127	£5·25
Kef T15	£6·00
Kef B110	£7·25
Kef B200	£8·25
Kef B139	£14·25
Kef DN8	£2·00
Kef DN12	£4·95
Kef DN13	£3·30
STC4001G super tweeter	£5·70
Richard Allan CG8T d/c r/surr.	£6·35
2½in 64 ohm, 70mm 80 ohm, 70mm 8 ohm	£0·65
2½in 75 ohm	£0·50
7in × 4in 3 or 8 ohm	£1·40
8in × 5in 3 or 8 ohm	£1·50
10in × 6in 3, 8 or 15 ohm	£2·30

SPEAKER KITS

Baker Major Module	each £10·75
Decca London Ribbon Horn	£26·00
Decca London Crossover	£6·50
Goodmans Mezzo Twinkit	pair £36·50
Helme XLK25	pair £22·00
Helme XLK30	pair £14·95
Helme XLK50	pair £39·95
Jordan Watts Module	£14·75
Kefkit 1	each £20·95
Kefkit 3	each £36·75
Peerless Dome tweeter	£6·95
Radford BD25	£14·75
Radford MD9	£8·95
Radford HD3	£6·75
Radford FN12	£8·95
Richard Allan Twinkit	each £8·95
Richard Allan Triple 8	each £13·75
Richard Allan Triple	each £19·95
Richard Allan Super Triple	each £23·75
Super 8 RS/DD	£8·95
Wharfedale Linton 2 kit	pair £19·25
Wharfedale Glendale 3 kit	pair £34·50
Wharfedale Dovedale 3 kit	pair £52·50

Baker, Linear and Eagle PA disco amplifiers in stock. Send stamp for list.

FREE with speaker orders over £7

''HI-FI Loudspeaker Enclosures'' book.

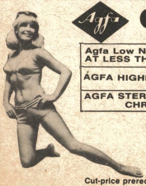
All units guaranteed new and perfect. Prompt despatch. Carriage and packing: speakers 38p each, speaker kits 75p each (£1·50 pair), tweeters and crossovers 20p.

Send stamp for free booklet ''Choosing a Speaker''

ALL PRICES QUOTED INCLUDE VAT

WILMSLOW AUDIO (Dept. PE)

Loudspeakers: Swan Works, Bank Square, Wilmslow, Cheshire, SK9 1HF.
Discount Radio, PA, Hi-Fi: 10 Swan Street, Wilmslow.



Cassettes

The best buy!

Agfa Low Noise Cassettes AT LESS THAN HALF PRICE!	C60 C90 C120	1 37p 50p 63p	5 £1·80 £2·48 £3·10	10 £3·50 £4·95 £6·20
AGFA HIGHDYNAMIC SUPER	C60 + 6 C90 × 6 C120	1 50p 68p 99p	5 £2·40 £3·35 £4·90	10 £4·70 £6·60 £9·80
AGFA STEREO-CHROM CHROMIUM DIOXIDE	C60 C90	1 85p £1·08	5 £4·20 £5·35	10 £8·30 £10·60

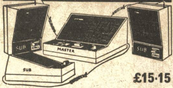
SAME DAY DESPATCH. P. & P. 15p per order

WILMSLOW AUDIO

(DEPT. PE)
10 SWAN STREET, WILMSLOW,
CHESHIRE, SK9 1HF

Cut-price prerecorded cassettes—send stamp for list

4-STATION INTERCOM



£15·15

Solve your communication problems with this **4-Station Transistor Intercom** system (**1 master** and **3 Subs**), in robust plastic cabinets for desk or wall mounting. Call/talk/listen from **Master** to **Subs** and **Subs** to **Master**. Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft and other accessories. P. & P. 50p.

NEW! AMERICAN TYPE CRADLE

TELEPHONE AMPLIFIER

ONLY **£11·95**

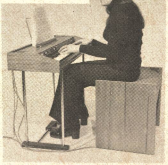
Latest transistorised Telephone Amplifier with detached plug-in speaker. Placing the receiver on to the cradle activates a switch for immediate two-way conversation without holding the handset. Many people can listen at a time. Increase efficiency in office, shop, workshop. Perfect for "conference" calls: leaves the user's hands free to make notes, consult files. No long waiting, saves time with long-distance calls. On/off switch, volume. Direct tape recording model at **£12·95**.

P. & P. 50p. 10-day price refund guarantee.

WEST LONDON DIRECT SUPPLIES (PE/5)
169 KENSINGTON HIGH STREET, LONDON, W.8

P.E. JOANNA

Electronic Piano



ALL PARTS WILL BE AVAILABLE

Keyboard, Keyswitch, P.C.B.s, Hardware, Semiconductors, Resistors, Capacitors

Complete kits or easy stages

Send 5½p stamp for details

Clef Products

31 Mountfield Road, Bramhall
Stockport, Cheshire SK7 1LY

NEWS BRIEFS

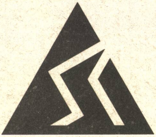
Symbol for Safety

THE British Standards Institution is to adopt a distinctive safety certification mark in addition to its famous Kitemark.

This is necessary because under article 10 of the EEC Low Voltage Directive, Community Members are required to conform to the safety requirements of the Directive in the field of electrical equipment by providing safety marks or certification or declarations of conformity.

Bodies authorised to grant such marks or issue such certificates have to be nominated by member governments. BSI, with other certification bodies, has been nominated by the UK Government for certain categories of electrical products.

To be considered for nomination in terms of the schemes for which currently the Kitemark operates, BSI needed a mark concerned *only* with safety requirements.



This has now been designed and is being registered by BSI. The new mark, based on a triangle incorporating the letters BSI in stylised form, will be a mark of conformity with a British Standard dealing only with safety, or with those parts which relate to safety characteristics in British Standards of wider application.

The stringent Kitemark testing and surveillance methods will be used in the certification of product safety. It is intended that, as with Kitemark procedures, a separate scheme will be devised for each standard, discussed and agreed with manufacturers, and then lodged with the Registrar.

Tubeless Cameras

EMPLOYING an advanced type image sensor, called a charge-coupled device (CCD), that performs the functions of Vidicon tubes in TV cameras, RCA are proposing to market two solid state tubeless black and white TV cameras in Europe in 1976.

The new RCA camera "eye" is claimed to be the first solid state image sensor to be fully compatible with present TV monitors and accessories, eliminating the need for equipment modification. The CCD image sensor produces standard pictures with a resolution comparable to images made from a two-thirds inch silicon Vidicon tube in present use.

The picture resolution of these tubeless cameras indicates that charge-coupled devices are now practical for a wide range of applications extending from surveillance cameras to more highly sophisticated use in industrial and military equipment.

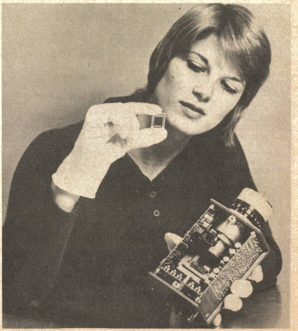
Scramblers Abroad

RECENT events have highlighted the difficulties of protecting business and commercial information, and it is recognised that the complexity of modern telephone networks makes them particularly vulnerable to accidental or deliberate eavesdropping. It is claimed that this security risk can be overcome by using the EMI Privateer, designed to be linked to the telephone system in a manner fully approved by the British Post Office.

The portable Privateer telephone scrambler

To promote overseas sales of the EMI EMISOUND Privateer telephone scrambler equipment, the company has entered into an agreement with Communications Security Limited, security consultants with world wide connections.

Basing their activities on the marketing techniques which have secured a rapid rise of interest in Privateer in the UK, the new agents will initially be concentrating on opening and developing outlets in the Middle East, South America, and certain African states.



New CCD tubeless TV camera

NEW DEVICES ...APPLICATIONS

ULTRASONIC REMOTE CONTROL

WITH the growing availability of ultrasonic transducers suited to various applications this as yet generally unused area of radiation is now coming in for much greater investigation.

Last month an ultrasonic system for the remote control of T.V. sets was announced, based on two purpose-built integrated circuits. The new system, made by ITT Semiconductors, uses multi-frequency coding, one frequency per channel, which has overcome many of the interference problems associated with earlier attempts to use ultrasonic energy in this type of application.

Of course, any system dependent on a frequency for operation must suffer from ageing effects, component drift causing frequency drift and subsequent system failure. However, the circuits developed by ITT overcome this by locking the transmitted and received signals to a crystal. In the primary application this is a colour sub-carrier crystal since one is available in the T.V. receiver and only one more is required for the remote transmitter.

Such crystals exhibit a tight frequency tolerance, a very slow ageing rate, and a small temperature coefficient. In this way no trimming is needed at either end of the system for satisfactory operation.

Two basic systems have been developed, a 15-command system and a 30-command system. Each has transmitter and receiver chip, and the associated circuitry required for both ends is fairly simple.

The 15-command system can be used for switching up to eight T.V. channels and additionally controlling three analogue functions such as volume, colour and brilliance. For each analogue function two channels are used, one to initiate upward and the other downward movement of the function concerned. In addition, in the system developed and displayed by ITT the commands could be given both at the receiver and on the remote control unit by means of touch switches.

The 30-command system carries other function controls such as up to 16 channels, a sound mute button, a "granny" button which centralises all main analogue controls and other commands.

OPERATION

A 15-command system is shown in Figs. 1 and 2, Fig. 1 being the circuit of the SAA1000 transmitter circuit. A diode matrix is required to provide the correct coding input to the pins *a* to *g* and since the input impedance at these pins is in the region of 10^{12} ohms touch operation is possible using suitably selected external pull-up resistors. Such a circuit is shown in Fig. 3.

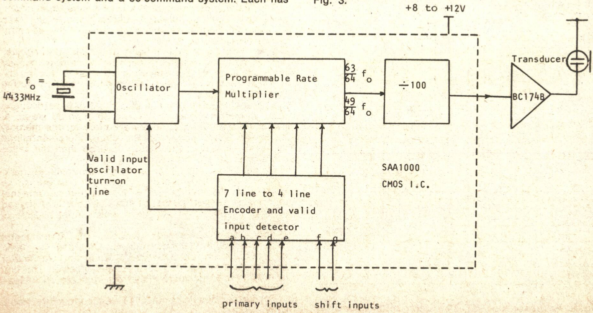


Fig. 1. Block diagram for the SAA1000 transmitter integrated circuit

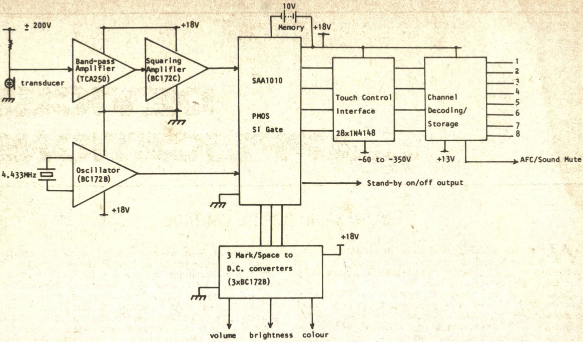


Fig. 2. Circuit diagram for 15-channel receiver

Normally all the inputs *a* to *g* rest at the positive rail voltage, held there by external pull-up resistors and an input is detected whenever one of the lines is pulled down to below half the voltage supply rail. Validity checking is supplied by making any valid input either any one of the lines *a* to *e* alone or jointly with lines *f* or *g*.

As soon as a valid input is detected the rate multiplier is set and the oscillator becomes operative to give a continuous ultrasonic output from the transmitter i.c. as long as the input is activated. A single transistor amplifier is sufficient to power the capacitive transducer used via a broadband step-up transformer.

The receiver circuit is shown in Fig. 2. This is identified as the SAA1010 chip and it operates by counting the local crystal-derived clock against the incoming ultrasonic signal and then decoding the count into the relevant channel.

Frequencies of less than 27kHz or greater than 54kHz are automatically invalidated internally and in any case an external band-pass amplifier reduces the strength of any unwanted signals.

Apart from these built-in immunity checks the receiver circuit contains a memory capable of storing the last value of each of the analogue conditions it controls. A small battery actuates this memory section during switch-off periods.

The analogue information is put out as a mark-space ratio variable between 1 : 30 and 30 : 1 in 30 steps. At switch-on and without the extra battery for the memory these ratios are preset on the chip to predetermined values. If, however, the battery is used then the ratios are as last set during use.

On-chip decoding of the analogue controls into mark-space ratios is provided on the receiver i.c.s but, so as to reduce the number of pins, programme channel information is not stored on the chip but is delivered instead in pulsed b.c.d. form whilst transmission is under way.

Four basic chips are available, the 15-command transmitter SAA1000 and receiver SAA1010, a silicon gate m.o.s. chip, the SAA1024 30-command transmitter and finally the SAA1025 30-command receiver. The first is in a 14-lead package whilst the rest are all 16-lead packaged.

For further details contact ITT Semiconductors, Foots Cray, Sidcup.

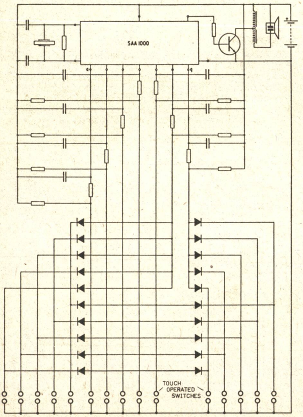
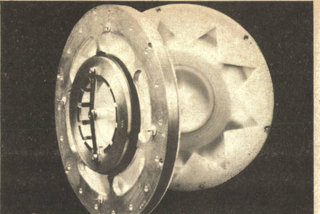


Fig. 3. Proposed circuit for an ultrasonic transmitter

LOUDSPEAKER BREAKTHROUGH

A new look at an old concept in loudspeaker design



Composite view of the new loudspeaker showing the rear partially obscuring the front face. The arrangement of the four connectors supplying power to the double voice coil are visible

Almost forty years ago two gentlemen, C. W. Rice and E. W. Kellogg, invented the loudspeaker construction which has ever since been the standard form used by almost every manufacturer.

Called the "mass and compliance" type of diaphragm, their loudspeaker design has changed little in the intervening years. The modern loudspeaker uses a small resistive or damping component to control the movement of the diaphragm and, at this time, the only way to come anywhere near achieving a frequency-independent system is as we all know to our cost, to use a multiplicity of units and associated crossover circuits.

A great deal of technology, effort and discussion has been put into current loudspeaker design, with, in the eyes of many, still questionable results. However, it seems possible that now yet another of the Rice & Kellogg ideas might provide a better solution to the whole problem anyway.

When making their original proposals they suggested that a resistive diaphragm, that is one which damps or absorbs the sound energy, would be the only type in which the electrodynamic forces would be directly proportional to the desired diaphragm velocity. Of course, at the time they were unable to make such a diaphragm through lack of materials and thus they settled, like all sensible inventors, for the working solution.

NEW MATERIALS

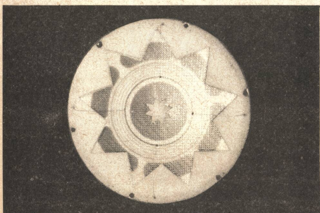
Now, using modern materials and techniques, Josef W. Manger, a radio retailer from Germany, has managed to create a loudspeaker which embodies the basis of the Rice & Kellogg resistive diaphragm concept (reported last month in Practical Electronics).

The new loudspeaker has been demonstrated to both an I.E.E. audience and some members of the technical press, and there is no doubt whatsoever that the Manger device is a serious contender for quality loudspeaker applications. Whilst all such demonstrations are open to attack on the grounds of location, suitable comparison examples and so on, the use of the new loudspeakers in an acoustically "bad" hotel room, but able to produce sounds very comparable with the original noises recorded, can only speak in their defence.

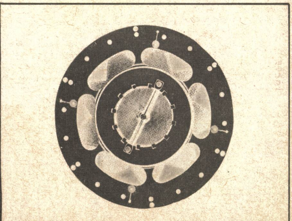
All such tests are, of course, subjective and often very personal but this is the first time the writer has seen any loudspeaker capable of demonstrably producing a square-wave output from a square-wave input over a frequency spectrum from 40Hz to 40kHz.

LOUDSPEAKER CONSTRUCTION

Even if the quality of the demonstration had been poor, and it certainly was not that, the construction of

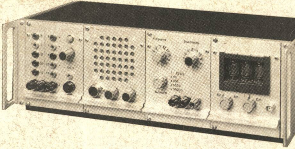


Front view of the diaphragm showing the centre and edge damping foam plastic and the annular voice coil



Rear view of the loudspeaker showing the light frame structure in silhouette

FOR THE FIRST TIME IN THE U.K. . . .



A typical application of this case system

WORLD FAMOUS MANUFACTURERS CARDFRAME/CASE SYSTEM DESIGNED WITH THE AMATEUR MARKET IN MIND . . . Precision made, elegantly styled and guaranteed to enhance any project lending itself to modular construction—synthesisers, mixers, test equipment, monitoring systems and for countless professional and industrial applications too. 19in rack mounting or free standing, the system comprises a range of modular inserts, panels, circuit boards, plugs and sockets. Illustrated leaflet and price list on request.

TRANSISTORS	
BC204	**11p**
BC209C	**11p**
BC182	**10p**
BC184	**11p**
BC212	**14p**
BC214	**16p**
BC213	**15p**
BC213L	**15p**
ZTX300	**15p**
ZTX500	**17p**
2N2484	**24p**
2N2904	**30p**
2N2905	**27p**
2N2219	**22p**
2N3054	**100p**
FETS	
2N3819	**46p**
2N5459	**60p**
DIODES	
1N5401	**21p**
1N914	**5p**
BA148	**25p**
1SJ50	**12p**
1GP7	**10p**
NOISE DIODES	
Z1J	**60p**
Z1M	**120p**
RECTIFIERS	
REC41A	**120p**
REC46	**255p**
REC70	**40p**
EA100/10	**100p**
MDA942A/1	**210p**

VOLTAGE REGULATORS	
µA7815	**220p**
723	**180p**
ARRAYS	
ML3046P	**75p**
CA3096AE	**120p**
OP. AMPS	
709/8 Dip	**39p**
710/TO5	**39p**
741	**37p**
748	**48p**
FETMOPA	**450p**
SPECIAL PURPOSE LINEARS	
SG3402N	**174p**
SG3402T	**174p**
SG1495D	**290p**
MFC6040	**100p**
MFC4000B	**70p**
T.T.L.	
7402N	**38p**
7410PC	**24p**
7420N	**24p**
7430PC	**23p**
7473N	**48p**
7475N	**75p**
7476N	**49p**
7489N	**660p**
7493PC	**89p**
74121J	**85p**
74122N	**80p**
74123N	**144p**
74150N	**210p**

RESISTORS

Triple rated high stability carbon film, **7p for 5**
0·5W metal oxide, **16p for 5**
Stocked in E12 values from 4R7 to 3M9

P.E. POWER SLAVES

Special components available while stocks last.

High Voltage

MPSL01 **39p;** MPSL51 **41p;** MPSU07 **69p;** MPSU57 **85p;** SDT9203 **150p.**

Constantan Wire

0·03 ohms/cm as specified for the POWER SLAVES. 20cm lengths **10p.**

LISTS

New lists are available for the:

P.E. SOUND SYNTHESISER;
P.E. MINISONIC;
P.E. RHYTHM GENERATOR

Please include 7p stamp or 9 × 4in S.A.E. with all requests for lists or information.

LOW PRICE ELECTROLYTICS

Axial lead types—mainly Mullard/Guest
10V—22µF **4p;** 100µF **6p;** 330µF **6p;** 2200µF **18p. 15V**—50µF **5p. 16V**—1500µF **18p. 25V**—470µF **10p** (PC Mtg). **63V**—100µF **8p;** 150µF **9p.**

WHILE STOCKS LAST!

UNLESS OTHERWISE STATED VAT AT 8% SHOULD BE ADDED TO FINAL TOTAL OF ORDER

POTS GALORE

24mm Carbon without switch. All values log. or lin. 5kΩ to 1MΩ	**25p** each
Wirewound 1W semi-precision. All values 10Ω to 25kΩ	**82p** each
Min. horiz. carbon presets, 100Ω to 2·2MΩ	**10p** each
Cermet presets, horiz. mtg., 100Ω to 1MΩ	**45p** each
Helical 10 turn W/W, 1kΩ, 5kΩ, 10kΩ	**£3·40** each

P E MINISONIC

MINISONIC P.C.B.'S

EA008a (Main Board), **£3·62** inc. VAT and U.K. postage.

EA008b (Power supply and Temp. Stabilisation), **£2** inc. VAT and U.K. postage.

CASSETTES NEW ! ! !

"SYMBIOSISOR"

a companion tape to Malcolm Pointons latest article on using the Minisonic, **"INTRODUCING THE MINISONIC".**

Each tape **£1·15** inc. VAT and U.K. postage. One of each for **£3.**

MINISONIC COMPONENT KITS—PRICES ARE DOWN

V.C.O. (2 required)	**£3·32**
V.C.F. (1 required)	**£4·58**
ES/V.C.A. (2 required)	**£5·38**
Voltage Ref.	**£0·58**
Ring. Mod. (1 required)	**£3·90**
Noise Gen. (1 required)	**£1·77**
Kbd. Control (1 required)	**£4·00**
HF Osc. and Det.	**£1·94**
Power Amps	**£2·60**

All above prices are for single kits of each type and include VAT, P. & P. Full details are included in lists.

Miscellaneous Items

5 way 180° DIN sockets	**27p**
5 way 180° DIN plugs	**34p**
Battery connectors	**9p/pair**
Hook up wire, 36 colours, ½ metre of each	**70p**
Min. DPDT toggle switch	**£1·20**

VAT should be added to quoted price of miscellaneous items.

SAVE BY PURCHASING A COMPLETE SET OF KITS AS DETAILED TOGETHER WITH SWITCH, BATTERY CONNECTORS, HOOK-UP WIRE AND P.C.B.

Price inc. VAT and U.K. postage £40·25

EATON AUDIO

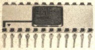
P.O. BOX 3, ST. NEOTS
HUNTINGDON, CAMBS. PE19 3JB

TERMS: MAIL ORDER ONLY.
C.W.O.
Cheques or P.O.'s payable to Eaton Audio. Orders over £5 free of P. & P. Otherwise please add 10p in the £1.

Buy it with Access

With a kit as complete as this, all you need add is a little time.

You may have found, from past experience, that your definition of 'complete' is not quite the same as other people's. And your so called complete kit comes minus a cabinet, or knobs, or a multitude of other bits and pieces.



That won't happen with a Heathkit. Take our very popular digital alarm clock kit. Every part you need will be there, right down to the solder. And you'll also receive a very easy to understand instruction manual that makes light work of assembly.

In fact all you need are a few basic tools and a few enjoyable hours of your time.

After which you may like to try your hand at our AR-1214 stereo receiver. Or even a TV.

And how about an ultrasonic burglar alarm disguised as a book?

Or, for a bookful of other ideas, just clip the coupon and we'll send you the Heathkit catalogue.

Otherwise call in and see us at the London Heathkit Centre, 233 Tottenham Court Road. Or at our showroom in Bristol Road, Gloucester.

You'll find it well worth your time.

Heath (Gloucester) Limited, Dept. **PE-55**,
Bristol Road, Gloucester, GL2 6EE.
Tel: Gloucester (0452) 29451.

To: Heath (Gloucester) Limited,
Dept. **PE-55**, Gloucester, GL2 6EE.
My free Heathkit catalogue, please.
Name____________________
Address____________________
____
__________________Postcode________

Remember easy terms are available with the Heathkit Monthly Budget Plan.

HEATH
Schlumberger

'BIG' Discounts

ALL PRICES INCLUDE V.A.T.

SPEAKER BARGAINS	**£**
EMI 13in × 8in 3 or 8 ohm	
Plain	2·05
With Co-Axial Tweeter 8 ohm only	2·20
With Tweeter and Crossover 3, 8 or 15 ohm	3·95
Type 350, 8 ohm, 20W	7·95
6½in, 8 ohm, 10W	2·60
8in, 8 ohm, 10W	4·50
12in, 8 ohm, 20W	6·70
8in × 5in, C/Mag. 5W, 3, 8 or 15 ohm	1·40
8in × 5in, Dual cone 8 ohm, 10W	2·55
ELAC 6½in 8 ohm Dual cone	2·15
ELAC 8in 8 ohm Dual cone	2·30
ELAC 10in 8 ohm Dual cone	3·50
GOODMANS 7in × 4in, 3 or 8 ohm	1·00
ADASTRA 10in, 8 or 15 ohm, 10W	3·55
BAKER GROUP 25 12in, 8 or 15 ohm, 25W	7·95
P. & P. 40p per speaker	
Also 5in, 8 ohm, C/Mag.	0·85
2½in, 8 ohm or 64 ohm	0·55
P. & P.	0·15

TWEETER AND CROSSOVER	
EMI 3½in, 3 or 8 ohm C/Mag.	1·30
Cone Tweeter 8 or 15 ohm, 10W	2·60
Cone Tweeter 8 ohm, 3W	1·45
Horn Tweeter 8 ohm, 20W	6·40
Dome Tweeter 8 ohm, 30W	5·60
Crossovers CN23 (3 ohm), CN28 (8 ohm), CN216 (16 ohm)	1·30
P. & P.	0·15

KIT FORM CABINETS, TEAK VENEER.	
12in × 12in × 6in with 8in, 8in × 5in or 6½in and 3½in cutout	3·80
17in × 10in × 9in with 8in or 13in × 8in cutout	4·50
18in × 11in × 9in with 8in × ¾in or 13in × 8in cutout for EMI 350	5·95
P. & P. each	0·50

MICROPHONES	
CM70 Planet stick metal, switch crystal	1·55
DM160 Dynamic omni-dir, ball metal	4·90
UD130 50K/600 ohm, uni-dir, ball metal	6·40
TW209	5·75
CONDENSER MIKE 600 ohm, uni-dir	9·35
Cass. Stick Mike with R. Control on/off switch (2·5 and 3·5mm J/Ply)	1·50
Cass. Stick Mike with R. Control (Philips type)	1·70
P. & P.	0·30

SOLDERING IRONS	
ANTEX CN240 15W	2·00
SK1 Kit (15 watt iron, 2 spare Bib, etc.)	3·40
X25 25W (low leakage)	2·00
P. & P.	0·15

CARTRIDGES AND STYLII	
ACOS GP91/2SC or 3SC Stereo comp.	1·10
GP93/1 or 95/1 Stereo crystal	1·50
GP94/1 or 96/1 Stereo ceramic	1·85
GP101 Crystal comp.	0·80
GP104 Stereo ceramic	1·95
BSR X5M or 5XH Crystal comp.	1·95
SX6M or SX6H Crystal comp.	2·00
SC5M Stereo ceramic	2·75
SONOTONE 9TAHC or 9TAHC/G diam.	2·00
3509 Stereo ceramic diam.	2·00
GOLDRING G850	3·25
G800	3·95
G800E	6·90
P. & P.	0·15
D. Diamond Stylii for above	1·25
G800/G850	1·95
G800E	3·95
P. & P.	0·05

BATTERY ELIMINATORS	
240V input 6, 7·5 or 9 300mA	2·95
12V D.C. input, 6, 7·5, 9V output, 1 amp	4·00
P. & P.	0·15

TAPES	Stnd.	LP	DP
5in	50p	65p	1·25p
5¾in	65p	80p	1·45p
7in	80p	1·10p	1·80p

PLASTIC LIBRARY CASES

5in Reels **18p.** 5¾in. **22p.** 7in. **25p.**

P. & P. 1–3 9p each. 4 or more lot 35p

LOW NOISE CASSETTES	1–5	6–10	11–20
C60	35p	33p	30p
C90	65p	43p	40p
C120	75p	52p	50p

Cassette Head Cleaner	0·35
P. & P. 1–5 each	0·05
6–10 lot	0·20
11–20 post free	

BIB ACCESSORIES	
Tape Editing Kit, Ref. 23	1·35
Recording Tape Splicer, Ref. 20	1·15
Cassette Tape, Editing, Ref. 24	1·50
Cassette Salvage Kit, Ref. 29	0·45
Stylus Balance, Ref. 32A	1·20
Spirit Level, Ref. 46	0·65
Hi-Fi Stereo Test Cassette	2·20
Groove-Kleen Record Cleaner	1·90
P. & P.	0·15

CALCULATORS	
SINCLAIR Cambridge	£12·95
SINCLAIR Cambridge with memory	£17·95
Scientific	£19·95

WHARFEDALE SPEAKER BARGAINS		P & P
Linton 2 Kit (pr.)	19·00	1·50
Glendale 3 Kit (pr.)	33·50	2·00
Dovedale 3 Kit (pr.)	52·00	2·00
Denton 2 Speaker (pr.)	30·00	2·50
Linton 2 Speaker (pr.)	39·50	2·50
Dovedale 3 Speaker (each)	42·00	2·50
Glendale 3 Speaker (pr.)	57·00	3·50
Kingsdale 3 Speaker (each)	59·95	4·00

Send 25p for COMPLETE CATALOGUE, refundable upon first order.
ALL OUR MERCHANDISE IS FULLY GUARANTEED
Subject to manufacturers' increase and availability

Riversdale Electronics

Mail Order Department PE5
P.O. Box 470, Manchester M60 4BU

the new loudspeaker would evoke interest in any exhibition of audio equipment. At first glance, the driver unit looks rather as if it were intended to be a chemical filter as the construction of the framing is light and open.

An outer ring (see the photographs) supports the outer edge of the diaphragm via a foam-plastic section of variable width. An inner ring, supported on thin webs just a little behind the outer ring, carries a large-diameter speech coil magnet and a central support point on which a foam-plastic pillar stands to which the centre of the diaphragm is attached.

DIAPHRAGM

So far, so good. It looks at least somewhat like a loudspeaker, if a rather shallow one. However, an examination of the diaphragm puts paid to the similarity ideas. It is soft, rather like a cross between old-style oilskin and putty, and a spare diaphragm was used to demonstrate just how pliable it really is. Forcing a finger into the material to make a deep "dent" which would normally ruin a cone only resulted in the dent slowly disappearing and the material resuming its original shape.

This ability to totally absorb at least slowly applied mechanical loads is achieved by the use of a knitted fabric coated in a suitably elastic material to provide a sound "piston".

To further assist in avoiding the usual problems of resonance, reflections from the outer cone edge, and cone break-up, the centre and the outer edge are both supported by foam plastic which is provided with a symmetrical but irregular edge. This absorbs most if not all of the energy which would otherwise be thrown back at the cone.

With the centre damping construction, it can be seen that the cone, if one can call it that, is vibrated at a ring spaced between the outer edge and the middle. This gives a larger radiating area whilst avoiding break-up problems. Indeed, the driver coil is itself interesting.

It is formed from two independent coils which, whilst driven in-phase in so far as the input signal is concerned, can be biassed with a d.c. signal so as to prevent massive excursions of the cone with any violent transients.

A ceramic ring magnet is used and the field energy is quite low, only of the order of 150mWb which compares with values of twice to three times this value for most modern units.

EFFICIENCY

There is no doubt that the new units are not quite as efficient as normal cone equipments. The relationship is of the order of 80 per cent, or where one uses 3W with a normal cone to obtain 96dB, the new unit requires 5W.

Apart from the nature of the edge and centre supports, the main secret of the new units seems to lie in the material of the diaphragm. In fact it does not act as a piston at all but, because of its viscoelastic nature, it operates in a bending mode. The attenuation factor of the material is very high, almost 1, and in practice the effective diameter of the unit decreases with increasing frequency.

One drawback so far experienced is that the lower resonant frequency of the unit varies with the power applied. At zero power it is d.c. but this rises to about 40Hz at full power with the units shown which were demonstrated handling up to around 25W peak.

Currently the units are being made individually by hand in Germany but soon mass production is to be instituted and it is understood that the manufacturers may well licence a suitable manufacturer here for local operation.

The man responsible for this novel application of an old idea is Josef W. Manger, manager of JWM, D 8725 Arnstein, P.O. Box 4, Karlstadter Strasse 3-5, and anyone interested should contact him direct. ★

BOOK REVIEWS

COLOUR TELEVISION SERVICING (2nd Edition)

By Gordon J. King
Published by Newnes-Butterworths
342 pages, 26cm × 16cm, plus fault procedure chart.
Price £4.40

THIS revised edition of the book first published in 1971 is aimed at a range of readers, from the technician changing from black and white to the enthusiastic amateur endeavouring to obtain the best performance from his set.

The eighteen chapters cover the basics of colour science, cameras and tubes, with details of the receiver from aerial to display. Chapter eleven onwards, test instruments, fault locating, field servicing and tube symptoms are especially helpful as is the new chapter seventeen—Receiver Design Trends, with information about some of the many developments in thyristor power supplies.

As a whole this book is extremely readable with a minimum amount of mathematics and minimal references to N.T.S.C. The illustrations and photographs (four pages in colour) are excellent and the detachable fault procedure chart should give a good start in locating the general area of trouble.

R.J.G.

110 OPERATIONAL AMPLIFIER PROJECTS FOR THE HOME CONSTRUCTOR

By R. M. Marston
Published by Newnes-Butterworths
123 pages, 5½ × 8¾in. Price £2.80, cased

THE operational amplifier is probably doing more to alter the face of practical electronics, both domestic and industrial, than almost any other single item of technology. Thus any document which helps to expand our knowledge of this particular area of electronics is bound to be helpful.

The present book is filled with useful circuits culled from a broad spectrum of arts including audio, measurement and signal generation to mention but three. Whilst some will be familiar the fact that they are gathered in one volume is in itself an aid to location.

An introduction takes the reader through the basics of operational amplifier techniques and introduces one to the universally acceptable 741 device which is used throughout the book. This is followed by five chapters dealing with subjects such as a.c. and d.c. amplifiers, instrumentation projects, oscillators and multivibrators, sound generators and alarms and finally, relay driving and switching circuits.

All the projects are provided with discussion of the operational methods used and the various forms of circuit selected. Whilst one may find that one's favourite circuit is missing, as is the fate for analogue thermometry, for example, there is certainly sufficient information present to make up a circuit from the elements in the book.

One point is perhaps important. This is not a wiring diagram/p.c.b. layout textbook. The circuits are given with some design information and construction is left to the reader. Nonetheless it is still a very useful book.

R.D.R.

TRANSDUCERS...

PART 2 Measuring Temperatures & Physical Parameters

By P. R. ALLCOCK*

MANY materials have the property that their resistance changes with temperatures and some of these find application as temperature-sensing devices. For metallic conductors the changes are very small when compared with, say, negative temperature coefficient thermistors, but metals have the advantage that their resistance variation is nearly linear over wide temperature ranges. Thermometers based on this variation are usually called resistance thermometers. Semiconductor thermometers based on germanium, silicon and carbon exhibit negative temperature coefficients of resistance similar to the thermistors already mentioned.

RESISTANCE THERMOMETERS

These devices usually employ a wire element made of platinum, tungsten, nickel or nickel alloy, or special metallic films. The platinum resistance thermometer is the most accurate available and is used as the calibration standard in the International Practical Temperature Scale. Resistance values range from about 0·1Ω to 10kΩ and the useful temperature range is approximately −260°C to 1,000°C. Less expensive and widely used in many industrial applications are the nickel and nickel-alloy resistance thermometers which can be used over a temperature range of about −100°C to +320°C.

The unknown temperature is obtained from measurements of the resistance of the thermometer element in conjunction with published calibration curves, either for the individual thermometer or for the particular class of thermometer. For platinum, the properties are sufficiently well known that mathematical expressions have been devised to permit the user to determine the temperature from the resistance value.

For accurate work an iterative solution is usually necessary because of the complex nature of the expression. For temperatures within the range −180 to +620°C the empirical relationship known as the Callendar-Van-Dusen equation is normally used.

For more sophisticated applications a more accurate power series having 20 terms is available and carefully compiled computer programs are necessary to handle the calculations.

Over the range 0°C to 300°C the resistance variation for a platinum type thermometer is about 2 to 1 compared to a variation of about 1,000 to 1 for the resistance of a thermistor element over the same temperature range.

SEMICONDUCTOR MATERIALS

Silicon-crystal thermometers have been used for the temperature range −50°C to +250°C and offer a reasonably linear relationship but require individual calibration. Germanium crystals with closely controlled impurity levels have also been used in cryogenic (very low) temperature measurements, especially below 25° Kelvin, and also require individual calibration.

NULL METHODS

For constant or slowly changing temperatures the usual method of resistance measurement involves a Wheatstone bridge circuit arrangement whereas for more rapid readings a direct readout method is necessary. The thermometer element is usually remote from the measuring point and connection is therefore made by means of a three- or four-wire cable to provide compensation for the resistance of the connecting leads.

Fig. 2.1 shows one possible circuit arrangement. Terminals *A*, *B*, *C* of the bridge are joined to leads 1, 2, and 3 respectively and a balance is obtained by adjustment of R_V. At balance we find that $R_V + r_1 = R_T + r_3 + R_B$ where r_1 and r_3 represent the resistance of leads 1 and 3 respectively. Rearranging this equation we have $R_T = (R_V - R_B) + (r_1 - r_2)$.

Ideally the term $(r_1 - r_2)$ should be zero as this will then minimise error due to temperature variations along the connecting cable. Resistor R_B can be set to any convenient value compatible with the adjustment range of R_V and the variation of R_T over the temperature interval of interest. The null sensitivity of a bridge is greatest when all four arms have the same resistance value and for this circuit this would imply that $R_V + r_1 = R_B + r_3 + R_T = R$.

This last equation can be used to indicate a suitable nominal value for R_B. Since R_T varies with the temperature being measured the choice of R_B is a compromise.

By switching points *A*, *B*, *C* to leads 4, 3 and 2 respectively as shown dotted, a second reading can be taken and the two results averaged to minimise error due to lead resistance variation.

JUNCTION ERRORS

Thermo-electric voltages at the junctions of any dissimilar metals can cause errors when the bridge is used with a d.c. supply. The use of a low frequency a.c. supply can help in this respect but introduces problems of its own. As with the thermistor bridge, self-heating due to current flow must be minimised as otherwise systematic error could be introduced.

An alternative approach is to pass a constant known current through the thermometer resistance element and to measure the resulting potential difference by, say, a digital voltmeter. This method is used in some semiconductor thermometer systems where the relatively large resistance change partly compensates for the low sensitivity of the method.

---

* North Staffordshire Polytechnic

THERMAL INERTIA

The most significant problem that the instrumentation engineer must solve is that of ensuring that the temperature sensing element or device is in fact at the same temperature as the subject for measurement. Often it is necessary to either protect the sensing element from the environment in which it operates or to cement or otherwise secure it in place. Materials commonly used for both these purposes have low thermal conductivity and consequently there is a significant temperature difference between the element and its environment.

In some situations the sensing element may absorb significant amounts of heat energy from the environment or the device to which it is attached, thus causing a change in the temperature being measured. Thermal inertia effects may also be a problem when rapid temperature fluctuations are being examined.

REFERENCE VALUES

Temperature reference points relating to specific states of matter are currently used to define the International Practical Scale of Temperature. Some of the states used are shown in Table 2.1.

Table 2.1

Temperature in degrees Kelvin	Physical "State"
20·28	Boiling point of hydrogen at standard pressure
90·188	Boiling point of oxygen at standard pressure
273·16	Triple point of water
373·15	Boiling point of water
692·73	Freezing point of zinc
1,235·08	Freezing point of silver
1,337·58	Freezing point of gold

STRAIN GAUGES

Yet another application of the "change of resistance" principle is in the field of strain measurement. Strain gauges are transducers in which the resistance of a wire or foil element is varied by physical means. The most universal type is the bonded foil gauge but bonded semiconductor gauges are also available and find increasing applications.

The basic construction of two types is shown in Fig. 2.2. The gauge is usually cemented to the surface of some part or member in which a strain will be produced by an applied stress. In the usual arrangement two or more gauges, are employed and arranged in such a way that the stress-induced resistance changes combine to cause an output whilst allowing cancellation of resistance change due to, say, temperature effects.

The foil gauge for example has a metallic pattern which gives a larger resistance change when stressed along the preferred axis. This usually occurs when the stress increases the foil path length and decreases the cross sectional area, both of which cause an increase in gauge resistance. The semiconductor gauge experiences a change in crystalline structure which leads to a change in resistance due to the piezo-resistive effect. The effect is much greater than that obtained with wire or foil gauges but the variation is less uniform.

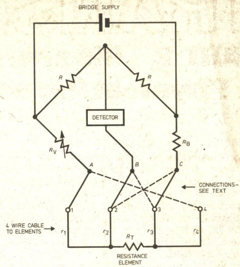


Fig. 2.1. One form of null bridge for temperature measurement

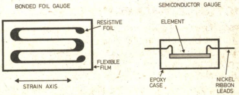


Fig. 2.2. The basic physical form of the foil and the semiconductor strain gauge

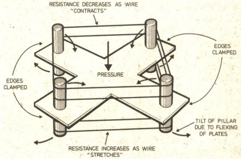

RESISTANCE DECREASES AS WIRE "CONTRACTS"
EDGES CLAMPED
PRESSURE
EDGES CLAMPED
TILT OF PILLAR DUE TO FLEXING OF PLATES
RESISTANCE INCREASES AS WIRE "STRETCHES"

Fig. 2.3. The biradial wire strain gauge where resistance changes are additive because of the physical arrangement

WIRE GAUGE

A further type is the unbonded wire gauge such as the biradial gauge shown in Fig. 2.3. In this type the resistance elements consist of fine wire wound round the small posts and connected in a bridge circuit. Pressure applied to the centre of the diaphragm causes a tilting of the four posts in such a way that the elements on one side of the diaphragm increase resistance whilst those on the other side decrease. The resistance changes are additive in that they both act to cause the bridge to become unbalanced in the same sense. Temperature induced resistance changes affect all four arms of the bridge equally and consequently errors due to temperature are minimised.

OTHER RESISTIVE CHANGES

Strain is not the only measurand that can be used to cause a change in resistance. For example electrolytes, in general, exhibit a resistance which varies with the degree of concentration, within certain limits. Elastomers and special paints have also been developed in which the applied pressure gives rise directly to a change in resistance of the material.

Strain gauges are sometimes used as the electrical transduction stage of more complex devices in which an electrical output is desired. Unbonded gauges find application in pressure measurement, accelerometers and similar devices. The dimensional deformation or strain of an "elastic" material is related to the force or stress by Hooke's Law and the proportionality is constant over a restricted range. However, excessive inputs can damage or alter the characteristics of many types of gauge.

FOIL GAUGES

The bonded foil gauge is widely used as it is cheap and readily cemented to the workpiece. The gauge must be aligned so that the strain coincides with the axis of the gauge. The resistance change occurs for two distinct reasons. Resistance can be defined by $R=\rho\frac{L}{A}$ where ρ is the material resistivity, L is the material length and A is the cross-sectional area of the material.

When the wire or foil is in tension, L increases and A is reduced, both effects giving rise to an increase in resistance.

The second reason is due to the change of resistivity when the material is under stress. Strain gauges can be used in both compression and tension and two of the commonly used arrangements are shown in Fig. 2.4.

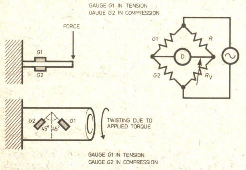


Fig. 2.4. Two commonly used arrangements of foil strain gauge where linear force and torque are under investigation

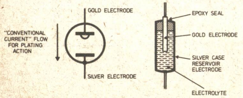

GOLD ELECTRODE
"CONVENTIONAL CURRENT" FLOW FOR PLATING ACTION
SILVER ELECTRODE
EPOXY SEAL
GOLD ELECTRODE
SILVER CASE RESERVOIR ELECTRODE
ELECTROLYTE

Fig. 2.5. The symbol for and basic structure of the electrochemical cell, useful in timing applications

Table 2.2

Nominal gauge factors for some common materials

Material	Nominal gauge factor
Nickel (pure)	−12·1
Nichrome	+2·1 to +2·3
Constantan	+2·0 to +2·1
Chromel	+2·5
Soft Iron	+4·2
Platinum	+4·8
Carbon	+20·0 (typical)
Solid state (doped crystal)	100 to 5,000

The output of strain sensitive devices is usually specified in terms of a so-called gauge factor. This is the relationship between the change in resistance, the basic resistance, the change in length and the basic length.

This can be expressed as $\frac{\Delta R/R}{\Delta L/L}$ where ΔR and ΔL represent the changes of resistance and length respectively and R and L represent the unstrained values of resistance and length.

The gauge factor is really a measure of the sensitivity of the transducer and a typical gauge might have a resistance of 100Ω to 150Ω and a gauge factor of approximately 2·0. Nominal gauge factors for some common materials are given in Table 2.2.

The main problems met with strain gauges are the requirement for care in mounting, the fragility and the need for temperature compensation.

Mounting requirements are usually specified by the manufacturer and the instructions should always be followed if reliable results are to be obtained. It is the quality of the cement bond that determines the coupling between the resistance element and the workpiece. A dummy gauge, positioned to experience the same temperature as the working gauge is a useful technique for temperature compensation although multiple gauge systems achieve the same result and give a greater output due to the "additive" resistance changes.

Thermal-potential effects can be avoided by using a.c. for the bridge supply and amplification of a.c. signals is easier than d.c. Self heating effects must be kept small and pulse excitation has been used in some applications to give a greater peak output voltage whilst keeping the average heating effect to a minimum.

ELECTROCHEMICAL CELLS

Special electro-chemical cells are now available that can be utilised for the measurement of total charge flow or time. The cells rely on the movement of ions between a silver case and an inner gold electrode, Fig. 2.5.

The direction of ion movement depends on the direction of current flow and when the gold inner electrode is free of ions the resistance of the cell and hence its voltage drop rises.

During the "plating" process the cell behaves essentially like a low value resistor of around 30Ω and for normal current levels this implies a voltage drop across the cell of a few millivolts. This state continues during the clearing or de-plating period until the gold electrode is completely free of silver ions. The cell voltage-drop then increases rapidly to about 1·2V. An approximate equivalent circuit is shown in Fig. 2.6.

The switch *S* opens when the gold electrode is unplated and the cleared cell then behaves as a low voltage Zener in shunt with a large capacitor of about 200μF. Whilst not strictly a transducer the device behaves as a variable voltage cell and can be used in event counting, timing and related applications.

THERMOCOUPLES

Thermocouples are heat-input/electrical-output self generating transducers and depend for their operation on the fact that if two different metal conductors are joined at their extremities to form a loop, a current will flow round the circuit dependent on the temperature difference between the two junctions.

This phenomenon of thermo-electricity was discovered by Seebeck in 1821 and named after him. The corresponding reverse action, whereby current flow through a junction of dissimilar metals gives rise to the liberation or absorption of heat, was not discovered until 1834 by Peltier. From the proportionality of the Peltier effect one might assume that the Seebeck e.m.f. would also be proportional to the temperature difference between the respective junctions, but this is not so.

A third effect, known as the Thomson effect, which is that of heat being liberated or absorbed when a current flows along a conductor in which there is a temperature gradient, accounts for the discrepancy and is similar to the Peltier effect but occurs in homogenous conductors rather than at a junction. These effects are in addition to the normal I^2R heating that occurs when a current I flows in a resistance R.

THERMOCOUPLE BEHAVIOUR

To understand the behaviour of thermocouples it is necessary to understand that the nett e.m.f. in a circuit of homogeneous conductors depends only on the nature of the metals and temperatures of the metal junctions. From this, if the junctions are at the same temperature, the circuit has zero nett e.m.f. In a circuit containing several dissimilar conductors and junctions the e.m.f. generated by any one junction is uniquely related to the temperature of that junction if all other junctions are kept at some constant reference temperature.

These situations are illustrated in Figs. 2.7 and 2.8. Assume that the temperature of the lower junction in Fig. 2.7 is T_2 and that T_2 is greater than T_1 the temperature of the upper junction, the nett Seebeck voltage will cause a current I to flow. The current will depend on the circuit resistance and the nett voltage. For the copper-constantan combination with $T_2 = 100°C$ and $T_1 = 0°C$ the nett voltage is approximately 4·2mV.

The nett voltage versus temperature difference relationship is not perfectly linear and at $T_2 = 300°C$ the voltage would be approximately 14·6mV. Fig. 2.8 illustrates the case where a measuring device has been incorporated and it can be seen that two additional junctions have been introduced at *A* and *B*. If *A* and *B* are maintained at the reference temperature T_1 no error is introduced by the meter even though the circuit between *A* and *B* may not be entirely made of copper. (If other junctions of dissimilar metals exist within *M* these should also be at the temperature T_1.)

Present day thermocouples cover a very wide range of temperatures from about −250°C to +1,600°C with

Table 2.3
THERMOCOUPLE CHARACTERISTICS

Temperature	Iron—Constantan	Chromel—Alumel	Copper—Constantan	Platinum—Platinum Rhodium
°C	mV	mV	mV	mV
−100	−4·63(41)	— (—)	−3·35(28)	— (—)
0	0 (50)	0 (40)	0 (38)	0 (5·6)
+25	+1·28(52)	+1·00(40)	+0·99(41)	+0·14(6·0)
+50	2·58(53)	+2·02(41)	+2·04(43)	+0·30(6·5)
+100	5·27(54)	4·10(42)	4·28(47)	+0·64(7·3)
+200	10·78(56)	8·13(40)	9·29(53)	+1·44(8·5)
+400	21·85(55)	16·40(42)	— (—)	+3·25(9·5)
+1,000	— (—)	41·13(39)	— (—)	+9·57(11·5)

Figures in brackets represent the rate of change of voltage with temperature in μV/deg C
Reference junction is 0°C for all types

Approximate Useful Temperature Range

Iron—Constantan	−200°C to +900°C
Chromel—Alumel	−180°C to +1,100°C
Copper—Constantan	−250°C to +400°C
Platinum—Platinum Rhodium	0°C to +1,500°C

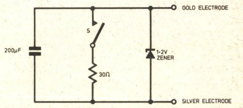


Fig. 2.6. The equivalent circuit for the electrochemical cell

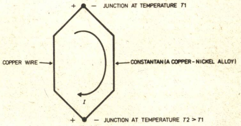

+
−
JUNCTION AT TEMPERATURE T1
COPPER WIRE
CONSTANTAN (A COPPER-NICKEL ALLOY)
I
+
−
JUNCTION AT TEMPERATURE T2 > T1

Fig. 2.7. Thermocouple current with dissimilar conductors and a temperature difference between the two junctions

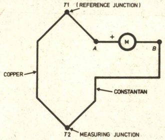


Fig. 2.8. Effect of introducing a measuring device and associated extra junctions

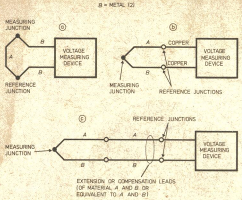


Fig. 2.9. How the thermocouple and measuring device can be interconnected

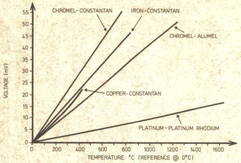


Fig. 2.10. Output/temperature curves for various thermocouple materials

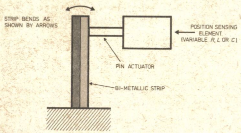

STRIP BENDS AS SHOWN BY ARROWS
POSITION SENSING ELEMENT (VARIABLE R, L OR C)
PIN ACTUATOR
BI-METALLIC STRIP

Fig. 2.11. Basic bimetallic device where dissimilar metals produce mechanical action when subject to temperature change

thermoelectric potentials of 10 to 70μV/deg C. Long term stability is not as good as that obtainable with the best resistance thermometers and at high temperatures many thermocouple materials suffer gradual embrittlement due to oxidation or reduction.

Thermocouples can be made up from base metals, rare metals or non-metals such as semiconductor materials. The most commonly used thermocouples are listed in Table 2.3 and the variation of output voltages with temperature is illustrated in Fig. 2.10. As with resistance thermometers, a wide range of protection sheaths are available for thermocouples. These are often of steel or ceramic depending on whether imperviousness to hot gases or chemicals, protection from oxidising or reducing agents and mechanical strength are required. Sheaths tend to slow the response due to increased thermal inertia.

REFERENCE JUNCTIONS

The reference junction in a laboratory can be provided by using melting ice in a thermally insulated flask but for industrial environments a specially made temperature-compensated junction is often used. The thermocouple is often well-removed from the point at which the information is required and special compensating leads are available for this purpose. These may be simply finer gauge wires of the same materials as the thermocouple wires, or special alloys which match the thermocouple characteristics over restricted temperature ranges.

In the latter case the compensated leads must be correctly connected to the thermocouple leads as each wire only "matches" one of the thermocouple materials.

Three possible arrangements for connecting a thermocouple to the measuring device are shown in Fig. 2.9a, b and c, and the position of the "cold" reference junction is clearly indicated for each case. Method (a) is suitable when the indicator is close to the point at which the measurand exists.

Method (b) avoids the need for long lengths of expensive thermocouple material but requires the two reference junctions to be at the same temperature and fairly close to the environment being investigated.

The third method, (c), uses extension leads having thermoelectric properties that are vitually identical with the actual thermocouple leads to which they are connected. The two reference junctions can now be well removed from the environment being measured but must still be held at the same temperature.

For accurate measurements the voltage measuring device should impose negligible loading on the thermocouple circuit. High input-resistance digital voltmeters are taking the place of the earlier potentiometer voltage measurement systems and in automated systems analog-digital convertors change the low-level thermoelectric voltages to a form more suited to the computer or other data-processor.

THERMOPILE

A thermopile is simply a series arrangement of several thermocouples to give a higher output. In some applications the multiple structure is used to sense the average temperature over a particular region of interest. Some types have blackened hot junctions to provide better absorption of radiant energy and are sealed into a container with transparent windows and lens to form a radiation pyrometer. Other types of pyrometers use mirrors to avoid the wavelength restrictions that occur with the lens type.

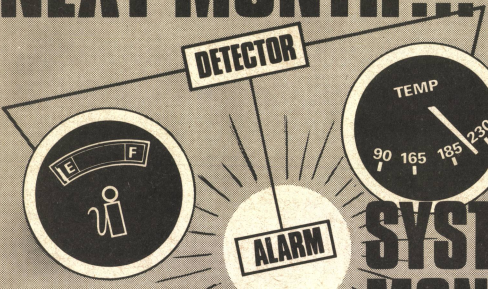
BIMETALLIC DEVICES

If strips of two metals having different coefficients of expansion are bonded together to form a composite leaf or spring, any subsequent change in temperature will tend to deform the original shape. The effect is increased by selecting metals with widely different coefficients of expansion and the resulting deformation is monitored by means of a displacement sensor, as shown in Fig. 2.11.

The arrangement is widely used in thermostats and similar temperature sensing devices. Careful control of the material properties is essential for reproducible results. In some types, electrical heating elements are also utilised to minimise mechanical hysteresis effects in the switching action.

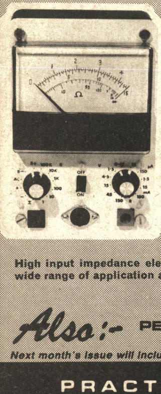
Next Month: Inductance Transducers

NEXT MONTH...



SYSTEMS MONITOR

Voltage detector system suited to use in the home, laboratory or, for example, for car gauge detection and alarm monitoring.



ELECTRONIC MULTI-METER

High input impedance electronic multimeter with a wide range of application areas.

REACTION TIMER

For use in examining the human animal speed of reaction in various situations.

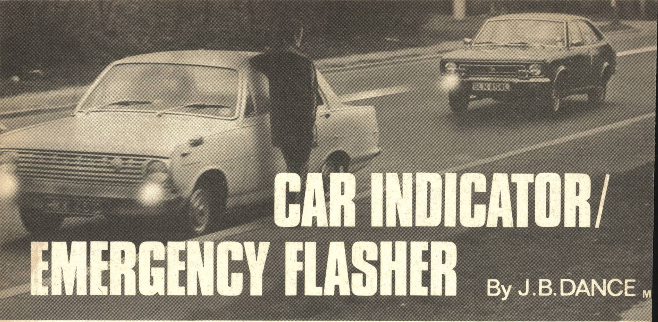
MUSIC MAKING with the MINISONIC

Also:- PE JOANNA

Next month's issue will include a free index for Volume 10 (1974)

PRACTICAL
ELECTRONICS

JUNE ISSUE ON SALE MAY 9—PRICE 30p



CAR INDICATOR/ EMERGENCY FLASHER

By J.B.DANCE M

For negative earth vehicles only

Almost all vehicles in current production employ a hot wire thermal switch for controlling the yellow direction indicator flashing lights. The failure of a flasher bulb produces an increased flashing rate which warns the driver that the signal is not being given by one of the lamps.

This article describes how the conventional thermal flasher unit can be replaced by a simple electronic circuit. The only semiconductor device required is an ITT integrated circuit which has been especially designed for automobile applications.

ADVANTAGES

The electronic circuit to be described has some advantages over conventional thermal flasher circuits, namely:

(a) When the direction indicator of the electronic unit is operated, the first flash occurs immediately. In systems using thermal flasher units, the operation of the direction indicator switch produces an initial "lamps off" state which precedes the first flash.

An electronic flashing circuit can therefore assist road safety by eliminating the short waiting period before the driver's intentions are made clear to other road users.

(b) If the relay is placed under the dash board, the clicking noise produced by the operation of its contacts provides a good audible indication that the flasher is operating. The normal warning lamp is also included in the circuit.

(c) A further advantage of the electronic system is the inclusion of an emergency flashing facility in which all four flasher lamps at the corners of the vehicle operate simultaneously. This facility is found on very few cars at present, although breakdown and other vehicles likely to attend accidents have it available.

(d) The conventional thermal switching system is quite reliable, but the use of a carefully constructed electronic system should improve reliability and, therefore, road safety.

The electronic circuit to be described provides all of the facilities offered by a conventional thermal flasher, including a much increased flashing rate when an indicator bulb filament has broken or has a broken connection in its wiring. The rapid clicking of the relay also provides an audible warning in these circumstances.

INTEGRATED CIRCUIT

The integrated circuit required is a TAA 775G power oscillator. This is a dual-in-line device, but three of the pins on each side of a conventional 14 pin dual-in-line device have been replaced by a small metal tab. One or both of these tabs must be connected to the negative (0V) power supply line.

The circuit used is shown in Fig. 1. The connections to the i.c. shown are those when the device is viewed from the top with the pins and tabs pointing downwards. The use of this device enables much simpler circuits to be employed than if discrete transistors were to be used.

CIRCUIT OPERATION

In the circuit, the capacitor C1 charges through R1 from pin 6. When the voltage across C1 has risen to a predetermined level, an internal voltage comparator (the input of which is connected to pin 5) will switch the states of the internal circuits of the device.

The voltage at pin 6 is now switched to a value which is little higher than that of the negative line (actually about +0·2V). C1 therefore discharges through R1 until the potential across this capacitor reaches a value which is low enough for the device to be switched back to its former state.

The voltage at pin 6 now rises rapidly to its former value of about +4·6V and C1 therefore commences to charge again through R1. Hence the oscillatory cycles are repeated.

When the potential at pin 6 is in its higher voltage state of about +4·6V, it is stabilised by an internal voltage stabiliser circuit. This ensures that the frequency of operation is almost unaffected by reasonable variations in the power supply voltage.

The capacitor C2 prevents any transient voltage changes in the car electrical system from affecting the circuit by causing spurious switching.

OUTPUT CIRCUIT

The output transistor in the i.c. is connected to pin 10 of the device. When the potential at pin 6 is high (that is, about +4·6V), the output transistor is non-conducting. The current passing through the relay coil to pin 10 is then less than 1μA.

When the circuit is switched, however, so that the potential of pin 6 is about +0·2V, the output transistor conducts. A current then flows through the relay to pin 10. The maximum permissible value of this current is 150mA, so the resistance of the relay coil should not be much less than about 100 ohms, since the battery voltage can reach about 14V on charge and one must allow for normal tolerances.

The circuit has been designed to operate satisfactorily from supply voltages in the range 9V to 15V.

In most circuits a protective diode would be required across the relay to prevent damage to the integrated circuit when voltage spikes are formed across the relay coil. These spikes occur when the current ceases to flow through the coil. However, the i.c. contains its own internal protective diode and no further diode is needed across the relay when this device is employed.

CONTROL VOLTAGE

The i.c. operates in one of three states, according to the control voltage applied to pin 7. The control voltage affects the circuit only when the output transistor is non-conducting. The three states are:

(a) When the potential at pin 7 is equal to (or slightly less than) the positive supply potential applied to pin 1, the oscillation is blocked. As the potential of pin 5 rises, no switching occurs and the relay is never energised.

(b) When pin 7 is earthed or when its potential does not exceed about +0·35V, the circuit oscillates at a frequency given by the equation:

$$f = \frac{800}{R1(k\Omega)C1(\mu F)}\ \text{Hz}$$

(c) When the pin 7 potential is between about +0·45V and +5V, the circuit switches earlier as the potential across C1 rises. The frequency is thus increased by a factor of about 2·2 above its previous value when pin 7 was earthed. The duty cycle (time on/time off) is also increased from about 0·8 to 1·1.

COMPONENTS . . .

Resistors
R1 5·6kΩ ¼W
R2 82Ω 2W
All 10% carbon

Capacitors
C1 100μF 6V elect.
C2 0·5μF 6V polyester

Integrated Circuit
IC1 TAA 775G
(Phoenix Electronics Ltd., 139 Havant Road, Portsmouth, Hants)

Relay
RLA 12V relay, 10A contacts, coil resistance 110Ω (8 pin relay Doram)

Miscellaneous
S2 T.p.s.t. 4A toggle switch
International octal valve socket. LP6–12V 1·2W emergency flasher monitor lamp

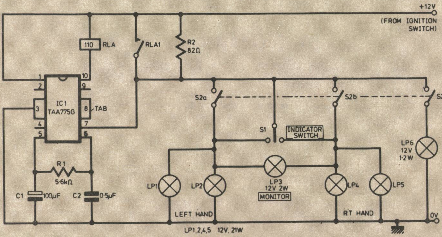
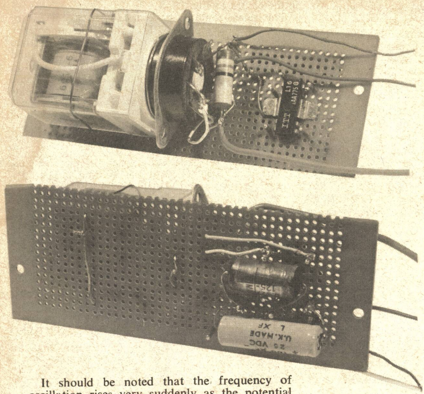


Fig. 1. The circuit of the direction indicator and emergency flasher unit. The connections of the TAA 775G are shown as viewed from above



Prototype assembly of the Car Indicator / Emergency Flasher. Since the wiring layout is not critical and so few components are involved, no interwiring details are given. The unit should be installed under the dashboard and all connections to existing circuitry should only be made after examining the car's wiring diagram

It should be noted that the frequency of oscillation rises very suddenly as the potential of pin 7 rises from +0·35 to +0·45V. There are only the two frequencies of oscillation for any given values of R1 and C1.

The values of R1 and C1 shown will result in a flashing rate of about 85 per minute when the pin 7 potential is less than +0·35V. Tolerances in component values (especially in that of C1) will produce some variation in frequency between similar circuits with the same nominal component values, but the flashing rate obtained should always be well within the legally permitted limits.

FUNCTIONING

The car power supply voltage is always applied to the integrated circuit whenever the ignition is switched on. The quiescent current consumption is only about 8mA.

When S1 and S2 are both open, pin 7 has a potential of about +12V, since it is returned to the positive supply line via R2. This potential at pin 7 prevents oscillation from occurring.

When S1 is switched to the "left" position, the resistor R2 forms a voltage divider with the parallel connected lamps LP1 and LP2. The lamps have a very low resistance and therefore the potential at pin 7 falls to less than +0·35V. The relay closes immediately and the lamps LP1 and LP2 are illuminated, but are extinguished when the relay opens. Flashing continues as C1 repeatedly charges and discharges.

Similarly, if S1 is switched to the "right" position, LP4 and LP5 will flash. With S1 in either the 'left' or 'right' position, the monitor lamp LP3 inside the vehicle will flash with the other lamps to indicate to the driver that the flashers are working.

If S1 is in the "left" position and either LP1 or LP2 has a broken filament, the potential divider consisting of R2 and the remaining good lamp will apply a voltage exceeding +0·45V to pin 7. The monitor lamp LP3 and the good flasher will therefore flash at a much increased frequency (about 180 flashes per minute). Similarly, if S1 is switched to the 'right' position and LP4 or LP5 has a broken filament, the same high flashing rate will occur.

EMERGENCY FLASHING

If the emergency flashing switch S2 is closed, the lamps LP1, LP2, LP4 and LP5 will all flash simultaneously at the normal rate of about 85 flashes per minute. This is an excellent way of warning other road users that a road hazard (such as an accident) is present near the vehicle.

The lamp LP6 is a warning lamp inside the vehicle which flashes with the emergency lamps. It should be noted that if one or two of the flasher lamps have broken filaments, there will be no change of flashing frequency in the emergency position. However, any broken filaments should have been previously detected when the flashers are used as direction indicators, since their use as emergency flashers is likely to be a very rare occurrence.

The direction indicator monitoring lamp, LP3, does not flash when the switch S2 is closed for emergency warning flashing.

The emergency flashing system of Fig. 1 will operate only when the ignition is switched on.

POTENTIAL DIVIDER TOLERANCE

The value of R2 is by no means critical, but a widely incorrect value can result in an incorrect flashing rate. In the prototype it was found that if the value of this resistor exceeded about 110 ohms, the normal flashing rate occurred even if a bulb had a broken filament. On the other hand, if the value of R1 was less than about 50 ohms, the high flashing rate occurred even when all of the flasher bulbs were good ones.

CONSTRUCTION

The TAA 775G is best mounted on a printed circuit board specially designed for the purpose with slits for the tabs of the device. However, most readers will not have the facilities for making such a board. It is therefore normally convenient to carefully bend the tabs of the device upwards so that the pins of the device can be inserted into a "Lektrokit" board whilst the tabs remain above the board. One can solder the connections directly to the pins and this will hold the device in position on the board.

The relay is fitted into a standard "international octal" type of valve socket. Pins 2 and 7 are connected to the relay coil, whilst pins 1 and 3 are the pair of normally open contacts used in the circuit being described. The other contacts are not connected in the circuit of Fig. 1.

The relay contacts have to switch a current of some 3·7A (or about 7·1A when the emergency flashers are used), so a relay with an adequate contact rating is essential for high reliability and hence road safety. The surge current at switch-on is even higher than the above values owing to the low resistance of the bulbs used when their filaments are cold. The use of a miniature relay should not therefore be contemplated.

FITTING

The switch S1 is already fitted in the car and can be used together with the existing lamps LP1 to LP5 inclusive and their wiring. The emergency switch S2 should be installed well away from other switches so that it is not likely to be operated accidentally. LP6 can be fitted at any convenient place where its flashing light is not likely to remain unnoticed by the driver.

The circuit board is conveniently fitted under the dash board where the driver can hear the clicking of the relay contacts clearly. It may be convenient to place the whole circuit in a thick polythene bag before placing it under the dash board. ★

MILD & BITTER

THE POCKET CALCULATOR BORE By A.P.S.

It is unfortunate that new ideas always generate over enthusiastic responses, leading eventually to the emergence of a unique class of bore. The poor, innocent pocket calculator has unwittingly become the host of two particularly virulent strains which have gained a foothold in the home counties and appear to be spreading as far north as Merseyside.

These have been identified as "Borus-calculatii-simplex" (found in patients who have purchased the so-called "Four-function" calculators) and a related, but more lethal variety called "Borus-calculatii-sciencus" (found in the owners of the "Scientific" calculators.)

To be forewarned is to be forearmed, so it is well to have some knowledge of their habits and modus operandi.

They could be found almost anywhere but tend to favour workers' canteens, fashionable London clubs, pubs and public transport vehicles.

A slight rectangular shaped swelling in the region of the breast pocket is normally considered to be a positive diagnosis.

If any luckless member of the public wanders too close, the procedure which follows is fairly well established.

The calculator is withdrawn with a casual air and the fiery red digits will begin to blink and splutter in a hypnotic way, almost certainly attracting a glance of interest. The damage is done!

The ordeal begins with some torturous descriptive details of the particular model.

"Of course this has fully floating decimal point, a double re-entry constant button, facilities for extended multiplication and many other unique features which I won't bore you with old boy."

Then follows a demonstration of the number-crunching powers, during which the far reaching discovery could be made that 356 divided by 2·3 squared is "approximately" 67·29678639.

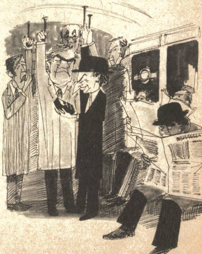
The fingers flash gracefully over the keys (with the dexterity of a Liberace) serving as a prelude to the next lecture which is concerned with some remarkable properties of the solid dodecahedron. Apparently all that is required is five sides, three angles and some cunning use of the aforementioned CONSTANT button. Some properties of pi and epsilon may then be discussed and of course rigidly demonstrated with worked examples.

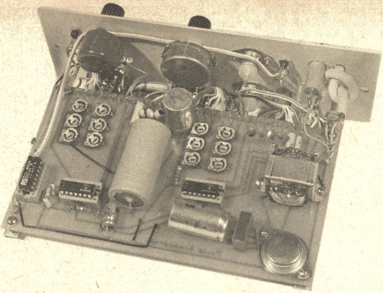
Blessed relief finally comes when the batteries expire.

There is little doubt that the disease is on the increase and is particularly prevalent on the London Underground, more so on the Metro Line.

During the rush hour, little knots of people may be seen, one hand hanging on to the strap, the other holding the calculator. They use their noses to operate the buttons in a jerky sparrow-like manner, much to the consternation of the other travellers.

The answer to the steadily growing menace has yet to be found. In the meantime, the only advice is attack! Buy one yourself and strap it prominently around the chest but do make sure it has a CONSTANT button, facilities for . . . etc., etc., etc.





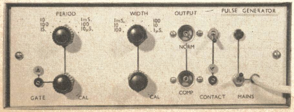
I.C. PULSE GENERATOR

By A.C. AINSLIE

All work carried out with digital integrated circuits involves the generation or processing of pulses or pulse trains. Complex pulse generators are now available for industrial or development laboratories where a wide range of complex pulse systems are needed, but for the home constructor there is rarely any need for anything other than a simple repetitive pulse train.

SPECIFICATION . . .

Pulse Rate	**0·1Hz to 100kHz (in six decade ranges)**
Period	**1s to 1µs (in six decade ranges)**
Output	**Two TTL compatible outputs available; "NORMAL" and "INVERT". The "NORMAL" output is high during the mark period. High is 4V and low is 0·5V.** **FAN OUT of 10 for each output.** **The "CONTACT" output closes during the mark period. Maximum ratings: 100V @ 200mA d.c. Maximum usable PRF approximately 200Hz.**
Gate Input	**TTL compatible—high or floating to enable the pulse train. Sink current to stop the pulse train is less than 2mA.**



The generator to be described was developed for TTL investigations and only a TTL-compatible output is provided. In order to increase the range of applications to cover other output requirements the pulse generator output can drive a small reed relay, the contacts being brought to the front panel to enable external voltages to be controlled up to a rate of a few hundred cycles. Alternatively some form of emitter-follower circuit can be used.

The generator is capable of a wide range of operating frequencies but with readily available switches the limit is six decade ranges. Although capable of operation in excess of 1MHz, pulse width of 100ns with a rise time of better than 20ns, the faster ranges were abandoned in favour of a slow range of 1Hz to 0·1Hz. This is handy for industrial process control and also enables digital counters to be seen counting at this low rate.

ELECTRONIC CIRCUIT

The complete circuit of the generator is shown in Fig. 1. Although it looks fairly complex it can be broken down into four sections, the period generator, timing pulse shaper, monostable pulse width and output circuit, and power supply. The first three are shown in Fig. 2 in block form.

Before describing the circuitry in detail we should perhaps see how these parts fit together to form a generator of variable period and width. Fig. 3 shows how the period generator, timing pulse generator and width monostable waveforms are interrelated to form the complete generator.

The waveform at A is the output from the period generator which can be a free-running multivibrator or astable. Variation of the duration of one cycle of the waveform varies the output period, P. In the present instance the period generator is made up from three of the four gates in an SN7400 (IC1).

If at an instant the inputs to G3 (Fig. 1) are at logic 1 then the output of gate G3 is at logic 0, and so the output of G1 is at logic 1. The output of G2 must therefore be at logic 0 and so the capacitor C1 to C6 selected by S1A will charge through VR7 and the preset VR1 to VR6 introduced by S1B. Thus the input to G3 will be high as the charging current is high but as the capacitor becomes charged, G3 inputs will fall to logic 0, sending G1 output to logic 0 and G2 output to logic 1 discharging the capacitor until the input to G3 once again goes to logic 1, repeating the cycle.

The duration of the cycle is dependent on the value of the charging capacitor and VR7 plus the preset selected by S1B. This preset is to enable each range to be calibrated in decade steps when VR7 is at zero resistance—i.e. shortest period for each range. The capacitors are arranged to give decade ranges of 1s to 10μs. The slowest range could be deleted and a faster range (1μs) added with a 4·7nF capacitor.

The open circuit input of G1 naturally acquires logic 1 when left floating and so the circuit operation is normal with no connection to the GATE. When GATE is taken to logic 0 or ground however the period generator stops operating, enabling fully gated operation.

G4 (the last gate in IC1), C7 and R1 form the timing pulse. C7 and R1 ensure that when the output of G3 goes to logic 1 the input to G4 only goes to logic 1 for about 70ns. G4 output therefore goes to logic 0 for 70ns during each period. This logic 0 pulse applied to IC2 inputs, A1 and A2, starts the monostable cycle.

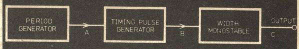


Fig. 2. Block diagram of the first three sections of the pulse generator

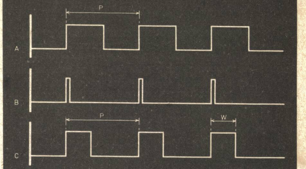


Fig. 3. Time relationships of the waveforms from the sections of Fig. 2 showing how the complete waveform is created

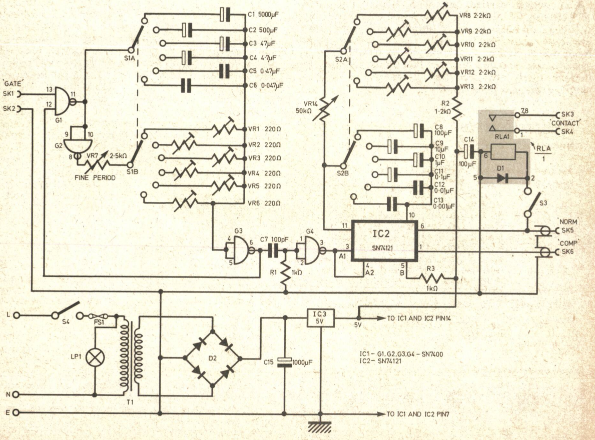


Fig. 1. Complete circuit diagram of the pulse generator. Period is controlled by switch S1, variable resistance VR7 and the presets VR1 to VR6. Width is controlled by S2, VR14 and presets VR8 to VR13

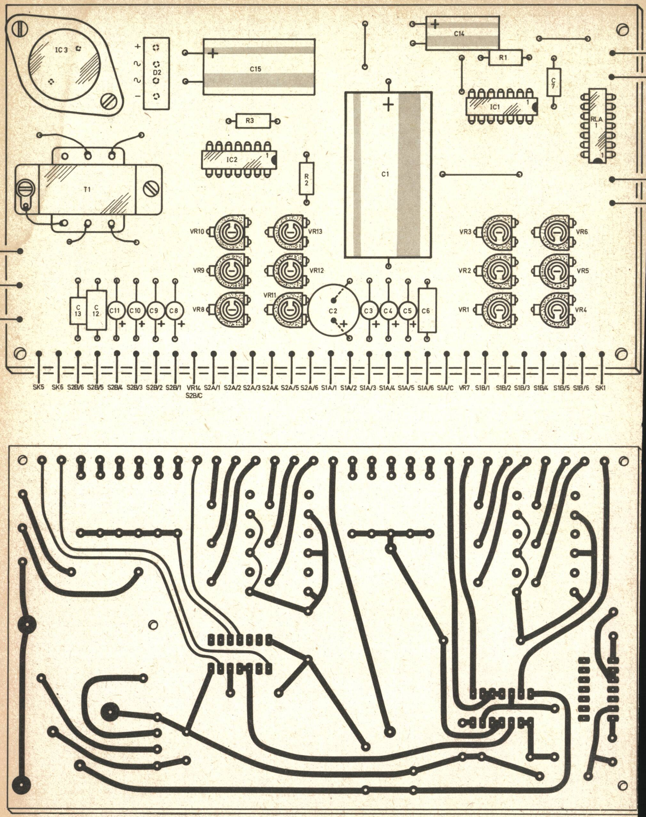


Fig. 4. Suggested p.c.b. pattern (full size) and component layout for the pulse generator, including the reed relay but excluding current sinking resistors

PULSE WIDTH

S2A and S2B select the time-determining components as previously. VR8 to VR13 are presets to enable the widths to be calibrated when VR14 is at minimum resistance. R2 is to limit the timing resistor values as required in the device specification.

The monostable chip, IC2, produces a pair of complementary outputs that are taken directly to the front panel sockets. R3 serves to ensure that input B of IC2 is maintained at logic 1.

At one point during the period generator waveform, the timing pulse generator produces a brief pulse as at B in Fig. 3. This point is usually the leading edge of the period waveform as shown.

COMPONENTS....

Resistors

R1	1kΩ
R2	1·2kΩ
R3	1kΩ

All 10%, $\frac{1}{4}$W

Potentiometers

VR1–VR6	220Ω preset pot. miniature
VR7	2·5kΩ potentiometer
VR8–VR14	2·2kΩ preset pot. miniature

Capacitors

C1	5,000μF
C2	500μF
C3	47μF, Tantalum
C4	4·7μF Tantalum
C5	0·47μF Tantalum
C6	0·047μF
C7	100pF
C8	100μF, Tantalum
C9	10μF Tantalum
C10	1μF Tantalum
C11	0·1μF Tantalum
C12	0·01μF
C13	0·001μF
C14	100μF, 15VW
C15	1,000μF, 16VW

All 5VW except where stated

Semiconductors

IC1	SN7400 (G1, 2, 3 and 4)
IC2	SN74121
IC3	MVR5V (R.S. Components) or 305-377 (Doram). 5V regulator i.c.
D2	20V, 1A bridge rectifier

Switches

S1	2-pole, 6-way
S2	2-pole, 6-way
S3	1-pole, on/off
S4	1-pole, on/off

Miscellaneous

RLA1	D.i.l. reed relay incorporating D1 (Doram)
T1	6V, 100mA output mains transformer
LP1	Neon indicator
FS1	1A mains fuse

Sockets, case, wire, solder, p.c.b. etc. to suit

Thus the timing pulses are spaced by the period set by the period generator. The timing pulses are usually arranged to be far shorter than the minimum output width required, in the present case about 70ns.

The timing pulses initiate the width monostable which gives a pulse on receipt of a timing pulse of length determined by the monostable's time constants. This gives an output pulse of duration, W, the pulse width. Thus the output train consists of a series of pulses of width, W, separated by period P.

The only power required by the circuit is +5V at pin 14 of each of the two i.c.'s. This is provided by an integrated voltage regulator fed from a conventional power supply. RLA1 is a miniature reed relay that can be switched to the output by S3. The contacts of RLA1 are taken to the front panel at SK3 and SK4 and can be used to control any external circuitry as required.

FAN-OUT

The basic unit supplies TTL-compatible pulses to a fan-out of ten per output. However if the outputs are required to source current then a resistor of 330Ω should be connected between each output line and the +5V bus. This reduces the fan-out but precludes the possibility of damage from shorting the outputs.

Of course the reed relay requires sourcing so it is advisable to connect a 330Ω resistor between the relay side of S3 and the +5V bus. This maintains TTL compatibility with S3 open.

CONSTRUCTION

Several methods will suggest themselves for the construction of this project but the author can only recommend a printed circuit board. A board of 88·9 × 152·4mm ($3\frac{3}{8}$in. × 6in.) will accommodate all the main components without too much crowding. Fig. 4 shows a suitable print layout—drawn full size.

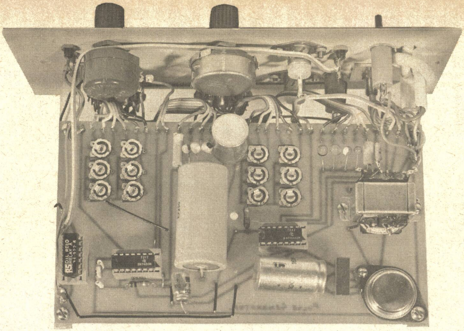
It is recommended that fibreglass board is used both for stability of performance and, because of the greater strength of fibreglass board, the mains transformer can be built onto the board.

The board can easily be made by constructors using the following recommendations. First of all the copper side of the board must be clean and free from scratches and grease. The design can now be copied onto the board using one of the marker pens now available. Etching is carried out in a saturated solution of ferric chloride.

The author has found that difficulty can be experienced when etching large boards due to uneven etching. The best way to overcome this is to float the board copper side down on the surface of the etchant. In this way all of the sludge falls from the board instead of staying on the surface. When completely etched, the board is washed and the resist removed with a solvent.

Most of the holes in the board can be drilled with a number 60 drill but $\frac{1}{32}$in. holes look neater for small components.

The i.c.s can be mounted on small sockets for ease of replacement. The relay can be purchased as a d.i.l. type and should be mounted on a socket



as, being a semi-mechanical device, it is prone to failure. The diode D1 is included in the d.i.l. package if the recommended component is used.

There are no special points to watch during the construction of the board, except perhaps that the i.c.s are the right way round.

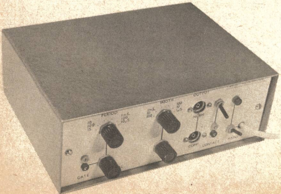
The front panel and case layout are shown in the accompanying photographs but they depend on the components used. The use of ten-way ribbon cable considerably eases the connection of the switches. In general all wiring should be short and direct otherwise "ringing" may occur on transients, spoiling the normally very clean output.

TESTING

When the construction has been completed and all the wiring checked, the generator can be tested.

When switched on, the voltage on pin 14 of both i.c.s should be 5V, within about 0·1V or so. An oscilloscope connected to the generator will verify correct operation.

If no output appears the scope probe should be connected to G3 output to verify that the period stage is working. The output of G4 should be a series of 70ns pulses.



These pulses can be difficult to see on some "ordinary" oscilloscopes which have low e.h.t. and not too wide a bandwidth. However, with Y amplifier set to 1V/cm and the trig set to "−ve, fast a.c." the stability control can be adjusted so that the scope just does not scan with no input. Applying the 70ns signal should now start up the timebase.

CALIBRATION

In order to calibrate the generator, the period and width controls, VR7 and VR14, are turned to minimum resistance. Then with S1 and S2 set to the fastest ranges, the period is set up on a calibrated scope using VR6. The width is then set with VR13.

S1 and S2 are then turned onto the next range and the process repeated with VR5 and VR12. This is continued until all of the ranges have been covered.

The value of VR7 at maximum resistance can be too high to enable G3 input to drop to logic 0. This is shown by the period oscillator stopping on the longer pulse widths on each range. If this occurs, VR7 should be shunted with a small resistor of value in the region of 3·9kΩ so that the oscillator functions correctly over the whole range of VR7.

In use the generator should present no problems as the operation is self-explanatory. However, a little care is needed as regards the output connections to avoid cable reflections and ringing. Generally, if 75Ω co-ax connectors are used together with 75Ω cable, no reflections will be experienced unless a cable of several yards' length is used. Experience will dictate the best loading for each situation—usually co-ax can be fed directly to a TTL gate input without any trouble at all. ★

THIS MONTH in

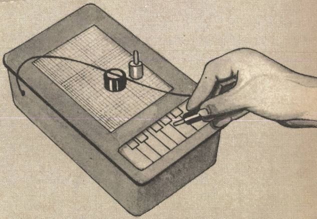
THE MAGAZINE FOR BEGINNERS

SPECIAL 8 PAGE SUPPLEMENT...

USING MULTIMETERS

Complete guide for this most useful piece of test equipment.
A must for all beginners.

EASY TO BUILD PROJECTS



WARNING WINKER

A low current indicator for battery powered equipment.

THE MINSTREL

A single octave stylus operated miniature organ.

ANTI-THEFT ALARM

Protect your car with this simple alarm.

MW/LW TUNER

Superhet design for use with almost any amplifier.

everyday electronics

MAY ISSUE
ON SALE
FRIDAY APRIL 18

Hi-Z

HIGH INPUT IMPEDANCE TECHNIQUES

By R.A.PENFOLD

It is common practice to design any piece of test equipment which is to draw current from the apparatus under test, to have an input impedance as high as possible. Thus the minimum current is drawn from the apparatus, and the test rig will have virtually no adverse effect on it. An accurate result is therefore obtained.

Recently a few items of commercial test gear have been put on the market, offering input impedances as high as 1,000 megohms.

F.E.T. CIRCUIT

A circuit diagram of a preamplifier using a field effect transistor in the source follower mode is shown in Fig. 1. This uses an inexpensive junction f.e.t. type 2N3819, and has a calculated input impedance of over 100 megohms. Resistors R1, R2, and R3 bias the transistor, and R4 is the source load. C1 is the input coupling capacitor, and C2 is the bootstrapping capacitor.

It is the use of bootstrapping, plus of course the very high input impedance of the f.e.t., which gives the circuit such a high input impedance, as, if C2 is removed, the input impedance will be only approximately 6·9 megohms. The source follower is the f.e.t. equivalent of the emitter follower in bipolar transistor circuitry.

Like an emitter follower, a circuit such as this has 100 per cent negative feedback and has unity (slightly less in practice) voltage gain.

The input and output are in phase. Therefore, if an input voltage is appled to TR1 gate, the voltage at TR1 source will alter by an almost identical amount. C2 couples this change to the junction of R1–R2–R3.

As the input signal causes a change in the potential at one end of R3, the signal via C2 will cause a similar change at the other end. Theoretically there will be no change in the current passing through R3, and to the input signal this will appear to possess an infinite resistance.

TRANSISTOR GAIN

In practice this is not so, as the gain between TR1 gate and the junction of R1–R2–R3 is less than unity. The gain of TR1 is only about 0·95, and there is also a small loss through C2, although this is only small compared to the 5 per cent loss through TR1.

The effective resistance of R3 will be increased to approximately 20 times its actual value, or 136 megohms. When one takes into account the input impedance of the f.e.t. itself, the input impedance of the amplifier is still in excess of 100 megohms.

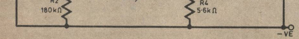


Fig. 1. An amplifier having an input impedance of over 100 megohms

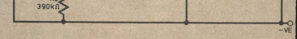


Fig. 2. This circuit using an operational amplifier i.c. has a typical input impedance of 400 megohms

When dealing with input impedances as high as this, the input capacitance of the circuit must be borne in mind, as even at audio frequencies this will noticeably reduce the input impedance.

The input capacitance of the circuit shown in Fig. 1 is about 8 to 12pF, and the exact figure will depend upon the individual f.e.t. used, and the component layout used.

OPERATIONAL AMPLIFIER CIRCUIT

Operational amplifier i.c.s can be used very effectively to obtain ultra high input impedances. Fig. 2 shows a circuit which uses a 741C or similar device, and a typical input impedance of 400MΩ shunted by 1pF.

As the output is coupled to the inverting input the circuit has unity voltage gain. The i.c. is intended to operate from two equal supplies, one being positive, and the other negative, with respect to earth. A biasing resistor is normally connected between the non-inverting input, and earth. As this circuit operates at a.c. only, this normal arrangement can be modified slightly. R1, and R2 form the centre tap on the supply, and R3 is the biasing resistor.

In order to prevent the biasing resistor from shunting the input, bootstrapping is applied via C2. The gain of the circuit is so close to unity that the bootstrapping is very effective, and the shunting effect of R3 is, to all practical purposes, non-existent.

D.C. CIRCUIT

A d.c. version of the circuit of Fig. 2 is shown in Fig. 3. Here equal positive and negative supplies are used. The biasing resistor is split into two parts (R1 and R2), and the output is coupled to the junction of the two halves. Bootstrapping is thus applied to R2, and the biasing resistors have very little shunting effect upon the input impedance.

The circuit uses the two offset null connections to the i.c. The offset null is adjusted by VR1, which is set with the slider half way along the track at first, and is then adjusted to give zero volts across the output terminals.

Both the circuit of Fig. 2, and that of Fig. 3 have good linearity and a low output impedance. The output has short circuit protection controlled by the i.c. itself. ★

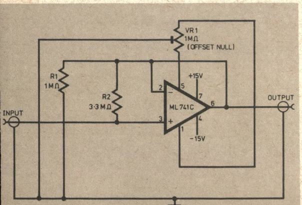


Fig. 3. A d.c. version of the circuit of Fig. 2

NEWS BRIEFS

New Plessey Radio System

A NEW experimental radio communication system, which provides two-way speech contact between underground workers and the surface, was successfully used in rescue operations at the Moorgate Tube disaster. The system, known as "Fire Ground" radio, is being developed by Plessey Avionics and Communications, under a contract from the Home Office Directorate of Telecommunications, for use by fire fighting services.

With this equipment, communication can be fully maintained from within steel-framed buildings, cellars, tunnels, caves, mines and similar locations. Each rescue worker is permanently in two-way contact with the base station and a talk-through facility is available which permits person-to-person contact. The degreee of penetration is quite outstanding.

The equipment consists of a number of special waistcoats, containing portable transmitter-receivers and a mobile base station, all of which may be rushed to the scene of a fire or other disaster.

It's A Hot Wind

FREE power from the wind is one of the "in" subjects nowadays so it is no surprising that a company has been formed specifically to make use of current technology to develop ways of utilising this free energy source.

The new company, called Wesco Ltd., is a joint venture of Control Technology of Peacehaven and Servotec of Redhill and technology for the generation of heat energy from the wind is said to be already in existence.

Wesco will manufacture wind systems embodying the latest in solar dynamics and design, and a new form of compact heat energy storage. Applications are legion and include greenhouse heating (a requirement which, it is claimed, in the UK alone uses three quarters as much energy as British Rail), agricultural heating and drying, and heating on large estates.

It is interesting to note that use has been made of helicopter expertise gained by Servotec and it is understood that the basic units to be made will be modular in concept.

PRACTICAL ELECTRONICS

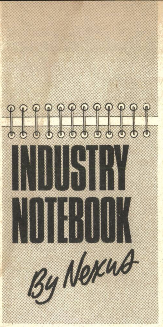
● P.E. INDEX FOR 1974

Next month's issue will include a *FREE* index for Volume 10.

● BINDERS

Easi-binders with a special pocket for storing blueprints and data sheets, etc., are available price £1·34 including VAT and postage. State required volume, e.g., Vol. 1, 2, 6.

Orders for Binders should be addressed to the Post Sales Department, IPC Magazines Ltd., Carlton House, 66 Gt. Queen Street, London, W.C.2.



INDUSTRY NOTEBOOK

By Nexus

SAFETY AT SEA

Like other companies with a big stake in consumer electronics, Decca is feeling the chill wind of the economic recession. But the company is holding up well in capital goods with turnover up 23 per cent at £32 million and profits up from £3 million to £3·6 million. Almost half the business is in professional navigation equipment in which Decca is still a world leader both in technology and volume of production.

Increasing pressure on shipping to observe the new mandatory traffic lanes in the English Channel has brought Decca a £350,000 order for improved surveillance radar which will extend the present 15 miles radius of the "policing" system to 50 miles. Some 35 ships a day are still breaking the traffic rules that are supposed to keep east-bound ships to the French side of the Dover Straits and west-bound ships to the British side. Ships straying from the traffic lanes are reported and in some cases are fined. The new installation is to follow the success of a pilot installation which has been monitoring channel traffic for the past three years. The "police" are H.M. Coastguards.

It isn't only the safety of ships and crews that is causing concern. It's pollution as well, especially from oil, and a major accident could do untold damage. The Government has recently set up a new Standing Committee on Pollution Clearance at Sea to keep constantly under review the arrangements for pollution clearance following a disaster. But prevention is better than cure and, here again, Decca Radar has taken a lead by producing a portable aid for bringing supertankers more safely into harbour. The equipment is currently being tested at a major oil port and an official announcement is expected soon together with some technical details.

Also doing well with their Situation Display radar which employs television techniques to give a bright radar display is Kelvin Hughes. The 45,000 ton P&O cruise ship "Canberra" has just been fitted with one in preparation for a busy cruise season.

When "Canberra" was launched in 1961 she had the then revolutionary system developed by Kelvin Hughes in which the radar picture was projected on to the plotting table and which was the forerunner of the KH "Photoplot" system. The new installation has the main display forward on the bridge and a slave monitor just aft in the navigation console. A video recorder may be used to take a complete record of the exact sequence of events as the ship is leaving and entering harbour.

The marine electronics business remains buoyant both in civil and defence applications and in defence, of course, there is new business in the protection of the oil rigs in the North Sea.

MICROWAVE LANDING SYSTEM

A first-class row has developed over the U.S. Federal Aviation Administration's decision to recommend a scanning beam microwave landing system in preference to the doppler system which is claimed to be technically superior. Plessey, who has been working hard on the doppler system in conjunction with RAE and with British government support, has gone into the attack with a strongly worded protest. The Hazeltine Corporation, also a proponent of the doppler technique, has gone further and has won a court order restricting the FAA proposal and charging the FAA with illegally excluding Hazeltine from further work in the competition for the final system.

Few of the companies involved in the competition for the best system (which will replace present ILS systems and bring millions of dollars of business in the next 20 years) is happy with the FAA recommendation except Texas Instruments and Bendix who appear to be on a winning streak. Hazeltine, ITT/Gilfilan and Plessey are clearly enraged. The present squabble has all the aspects of international bad feeling generated over the respective merits of the Decca Navigator and VOR systems of some 15 years ago.—Watch out for the next thrilling instalment.

PACKET SWITCHING

The Post Office Experimental Packet Switched Service (EPSS) is now virtually full up. F. W. Woolworth has now joined the scheme and major users will be nearly all the computer hardware manufacturers, BICC, Joseph Lucas and, possibly, Cambridge University who will investigate the value of EPSS to its growing network requirements.

Altogether, some 38 firms are taking part in the experiment, including Ferranti whose Argus 700E computers are used in the packet switching exchanges and for network monitoring.

ECONOMIC SEESAW

All business eyes are turned east these days. The fabled treasures of the east are now a reality with Iran, for example, trebling real income per head in the five years 1973 to 1978, while we in the west are hard put to it to maintain zero growth. Saudi Arabia is planning similar growth. So, it seems, is everyone else in the area.

It is an odd reflection of the times that while the BBC is making savage cuts in expenditure the tiny Sultanate of Oman has just ordered another £2 million of broadcast equipment from Pye TVT on top of the recent £7·7 million contract for a complete TV system and over a million for odds and ends, bringing Pye TVT orders from this one source to over 210 million in under nine months.

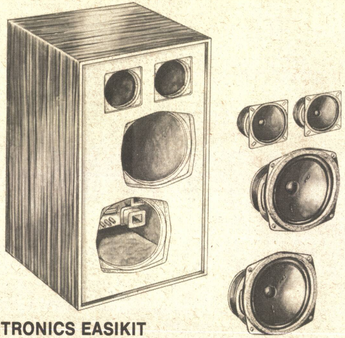
The population of Oman is 700,000, that of Glasgow is 900,000.—It makes you think!

DYNAMO

Ray Brown, the human dynamo who built up Racal in its early days (he was the RA part of the invented name) is top news again. Now Sir Raymond Brown, he is the new President of the Electronic Engineering Association, succeeding G. A. Smith of Plessey whose sudden death is regretted by all.

Sir Raymond relinquished his interest in Racal when he became the first Head of Defence Sales, Ministry of Defence, in 1966. He is now chairman and managing director of Muirhead, the facsimile transmission experts whose 3,000 installations world-wide include a number for Interpol and useage by over a dozen national police forces, as well as in more mundane applications. Sir Raymond got his start in electronics in 1934 as an engineering apprentice with Redifon.

Kit inspection



STUDIO ELECTRONICS EASIKIT

We invite your closest inspection of our loudspeaker kits. Here at last is a kit which doesn't require you to be either an electronic genius or a master carpenter. The assembly is simplicity itself, taking barely 15 minutes and requiring only a soldering iron, screwdriver and our easy to follow instructions, the cabinet being already built. 4 drive units provide excellent reproduction free from colouration, cabinet resonance and listening fatigue. Beautifully finished in teak or white.

SPECIFICATIONS
Impedance 4–8 ohms.
Power Handling 20W r.m.s.
Crossover Frequencies 250Hz, 5kHz.
Frequency response 30Hz to 20kHz ± 5dB.
4 Drive units, Bass, Bass/Mid-range, 2 Tweeters.

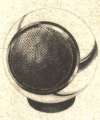
£42·50 per pair. Post free.

ready assembled £49·50 per pair. Post free.
Both plus 8% VAT.

Trade enquiries welcomed.

Demonstrations by telephone appointment.

SOUND SPHERES



The little speaker with the big sound! Only 4¾in diameter and weighing 700 grams, it is capable of handling 10W. A very versatile little performer, ideally suited to rear channel systems, in the car, extension speakers, etc. The magnetic base enables them to be mounted virtually anywhere. Superbly finished in black, white or orange.

SPECIFICATIONS
Impedance 4–5 ohms.
Power Handling 10W.
Response 100Hz to 16kHz.

£19·95 per pair. Post free.
Plus 8% VAT.

SEL

PE5

NAME ....
ADDRESS ....
Please forward by return ....
.... ***I enclose cheque/PO/Cash*** ....
Barclaycard or Access welcomed.

Studio Electronics Ltd

P.O. BOX 18, HARLOW, ESSEX CM18 6SH. Tel. 416771

Sound to Light Master Unit

600 watts per channel

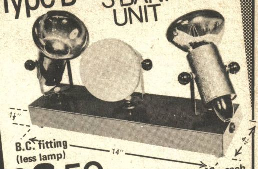
Connects to your loudspeaker or loudspeaker socket. The unit can be connected to your existing spotlight fittings or to our type A or B fittings.

Special Introductory Price

Including channel output plugs and mains input socket.

Only £29·95 incl VAT plus p&p £1.00

Type B 3 BANK UNIT



B.C. fitting
(less lamp)

£6·50 incl VAT plus p&p 40p each

Type A

B.C. fitting

£1·60 (less lamp) incl VAT plus p&p 25p each.

100 WATT SPOT LAMPS Red, pink, yellow, green, blue, clear. Only £1.00 each
Minimum 3 lamps £3.00 plus p&p 25p.
B.C. fitting

TRAFALGAR SUPPLIES
Dept.H.T., STANDISH STREET,
BURNLEY, LANCS.

TTL AT LOWEST PRICES!

Rapid delivery by 1st class post

All prices include VAT (at 8%)

All full specification by famous manufacturers

Type	1/24	25/99	100 +	Type	1/24	25/99	100 +
SN7400	0·14	0·13	0·12	SN7460	0·14	0·13	0·12
SN7401	0·14	0·13	0·12	SN7472	0·28	0·25	0·23
SN7402	0·14	0·13	0·12	SN7473	0·33	0·31	0·28
SN7403	0·14	0·13	0·12	SN7474	0·33	0·31	0·29
SN7404	0·16	0·15	0·14	SN7475	0·50	0·45	0·42
SN7405	0·16	0·15	0·14	SN7476	0·34	0·31	0·29
SN7408	0·16	0·15	0·14	SN7480	0·47	0·42	0·39
SN7410	0·14	0·13	0·12	SN7483	0·89	0·80	0·74
SN7412	0·16	0·15	0·14	SN7486	0·30	0·26	0·25
SN7413	0·32	0·31	0·30	SN7489	3·50	3·20	2·90
SN7417	0·30	0·29	0·28	SN7490	0·48	0·44	0·41
SN7420	0·14	0·13	0·12	SN7491	0·83	0·77	0·69
SN7427	0·27	0·25	0·22	SN7492	0·51	0·46	0·42
SN7430	0·14	0·13	0·12	SN7493	0·48	0·44	0·41
SN7432	0·27	0·25	0·22	SN7495	0·68	0·61	0·57
SN7437	0·29	0·26	0·24	SN7496	0·77	0·69	0·65
SN7440	0·14	0·13	0·12	SN74107	0·34	0·31	0·29
SN7442	0·69	0·63	0·58	SN74121	0·34	0·31	0·29
SN7445	0·89	0·82	0·76	SN74123	0·68	0·61	0·57
SN7447	0·89	0·79	0·76	SN74141	0·79	0·72	0·67
SN7450	0·14	0·13	0·12	SN74145	0·86	0·78	0·70
SN7451	0·14	0·13	0·12	SN74157	0·87	0·79	0·72
SN7453	0·14	0·13	0·12	SN74175	0·99	0·90	0·84
SN7454	0·14	0·13	0·12				

TTL may be mixed to qualify for quantity prices.

DIODES/TRANSISTORS

1N4001	4½p	ZTX107	10p	ZTX302	20p	ZTX313	14p
1N4002	5p	ZTX108	8½p	ZTX303	16p	ZTX500	14p
1N4003	6p	ZTX109	11½p	ZTX310	10p	ZTX501	15p
1N4004	6p	ZTX300	14p	ZTX311	12p	ZTX502	20p
1N4148	4p	ZTX301	15p	ZTX312	12p	ZTX503	16p

MULLARD C280 Polyester 250V capacitors (radial leads for PCB mounting) 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF **3½p.** 0·068μF **4p.** 0·1μF, 0·15μF **4½p.** 0·22μF **5½p.** 0·33μF **7½p.**

Send S.A.E. for latest catalogue (includes hints for using TTL, etc.). 10p P. & P. on orders under £2, otherwise POST FREE. ALL GOODS SENT FIRST CLASS POST. Discounts (excluding TTL): £5 to £14·99 10%, £15 and over 15%. ALL PRICES INCLUDE VAT.

J. C. JONES

Dept. PE5, 46 Burstellars, St. Ives, Huntingdon, PE17 4XX
(Mail Order only)

B. BAMBER ELECTRONICS

5 STATION ROAD, LITTLEPORT, CAMBS., CB6 1QE
Telephone: ELY (0353) 860185 (2 lines) Tuesday–Saturday

I.C. AUDIO AMPS, TBA800, rated 5W (sorry, no data), **£1** each.

MAGNETIC DEVICES PROGRAMMERS, contain 9 microswitches, with 9 adjustable drums for period switching (needs slow motion motor to drive drum, not supplied), many switching applications, **£1** each.

CURLY LEADS, 4 core telephone type, 2 for **20p.**

TRANSISTOR HEATSINKS, to take 2 × TO18 transistors, screw in clamps, block size 1 × ½ × ½in, with holes for mounting, 3 for **50p.**

VARIABLE STABILISED PSU, solid-state, 240V a.c. input, output 0–24V d.c. at 500mA, + 32V d.c. at approx. 50mA. Voltage controlled by external 5kΩ pot. Size 7½ × 4 × 2½in (less 5kΩ pot), **£5** each.

THREE-TURN WIRE-WOUND POTS, 5kΩ, for above, **75p** each.

LARGE DIE CAST BOXES (brand new ITT) 10¾ × 6¾ × 2⅛", **£2** each.

25-way ISEP PLUGS AND SOCKETS, 40p set (1 plug + 1 skt.).

DIN SPEAKER SOCKETS (2-pin) 4 for **30p.**

BNC INSULATED SOCKETS (single-hole mounting) **65p** each.

MAINS TRANSFORMERS

All 240V input, voltages quoted approx. RMS. (please quote type no. only when ordering).

TYPE 10/2, 10–0–10V at 2A, **£1·50** each.
TYPE 16/6, 16V at 6A + 45V at 100mA, **£4.**
TYPE 28/4, 28V at 4A + 125V at 500mA, **£4.**
TYPE 63/1, 6·3V at 1A, **85p** each or 2 for **£1·50.**
TYPE 129, 400V at 20mA + 200V at 10mA + 6·3V at 500mA, **£1·25.**
TYPE 72703, 400V at 10mA + 200V at 5mA + 6·3V at 400mA, **£1·25.**
TYPE 70462, 250–0–250V at 80mA + 6·3V at 2A, **£1·75.**
RADIOSPARES 500W AUTO TRANSFORMERS, 100–110–130–200–220–240–250V tapped input and output, step-up or step-down facility, ex-new equip. **£6.**

PLESSEY ELECTROLYTICS, 10,000mF at 63V, **75p** each.

ITT ELECTROLYTICS, high grade, screw terminals, 6,800mF at 25V, complete with mounting clip, **50p** each.

TV PLUGS, metal type, 6 for **50p.**

TV SOCKETS, metal type, 5 for **50p.**

TV LINE CONNECTORS (back to back socket), 5 for **50p.**

SOLDER (multicore) approx. 9yds., **25p.**

OA81 DIODES, 15 for **25p.**

OC200 TRANSISTORS, 6 for **50p.**

BSY95A TRANSISTORS, 6 for **50p.**

PERSPEX COIL FORMERS ½in dia., 5 for **25p.**

TELEPHONE-TYPE EARPIECE INSERTS, 50p.

REEDS (for reed relays, single pole make), 5 for **30p.**

MULLARD CERAMIC TUBULAR TRIMMERS, 1–18pF, 6 for **50p.**

I.C.s (some coded, some unmarked), 14-DIL types, mixed, untested, 20 for **25p.**

SMALL NEONS, 6 for **25p.**

24V, 2·8W LAMPS, MES type, 6 for **20p.**

MINIATURE SLIDER SWITCHES, 2 pole, 2 way, 5 for **50p.**

6·3V, 0·3A CAPLESS LAMPS, 10 for **25p.**
TORS, TO5 type, untested, 12 for **25p.**

STANDARD ¼in JACK PLUGS, 4 for **50p.**

PL259 PLUGS, 50p each, or 5 for **£2·25.**

REDUCERS (for small co-ax) to fit above, **15p** each.

SO239 SOCKETS (to fit PL259 plugs), **50p** each, or 5 for **£2·25.**

EF80 VALVES (new), **25p** each.

EZ81 VALVES (new) **25p** each.

HIGH QUALITY SPEAKERS, 8¾ × 6in elliptical, only 2in deep, inverse magnet, 4 ohms, rated up to 10W, **£1·50** each, or 2 for **£2·75** (qty. discount available).

TWIN HEAVY DUTY CABLE, PVC covered, 50/0·25mm, **15p** per metre, or **£10·20** per 100m reel.

TERMS OF BUSINESS: **CASH WITH ORDER** (minimum order £1) POST FREE (UK ONLY).
PLEASE ADD 8% VAT.
Export enquiries welcome. Callers welcome. Tues. to Sat.
Please enclose S.A.E. with *ALL* enquiries.

A selection of readers' suggested circuits. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought. Any idea published will be awarded payment according to its merits. Why not submit **YOUR IDEA?**

TELEPHONE BELL SYNTHESISER

Developed for use as a novelty in toy telephones or intercoms, the circuit of Fig. 1 gives a reasonable imitation of the normal telephone bell ring although the pulse periods to non-signal periods are even.

The Post Office system uses two rings of roughly 0·5s separated by a silence period of three times that amount. For simplicity the present circuit uses a count of four timing rather than a count of five which the Post Office system would need.

The basic multivibrator TR1, TR2 forms the clock for the unit. After the waveform has been given the current rising form so as to suitably trigger the 7474 i.c. by the Schmitt trigger TR3, TR4, it assumes the shape as at Fig. 2a.

This waveform is fed to a divide-by-four counter, IC1, which is positive-going edge triggered. This provides the waveform 2b, Fig. 2.

IC2 provides a warbling note, rather than a bell ring, and gates G1 and G2, capacitors C3 and C4, and resistors R10 and R11, form a multivibrator running at a few Hz.

The multivibrator switches a similar but much higher-pitched multivibrator formed by G3 and G4 to produce the warbled tone shown in Fig 2c. This is pulsed as shown by utilising the spare gate input to G4 and it is also switched slowly on an off by applying the Fig. 2b waveform to one of the inputs of gate G1.

The final output waveform is as at Fig. 2d and this is fed directly to a crystal microphone insert, adequate for most purposes but amplifiable if required.

If the unit is used in equipment containing a 4·5 to 6V supply the battery B1 can be omitted, together with R9 and D1.

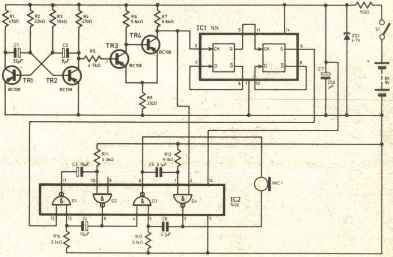


Fig. 1

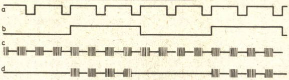


Fig. 2

TWO-WIRE SIGNALLING SYSTEM

The five devices used in the circuit of Fig. 1 make up a very simple signalling system which can give four indication states using only two wires.

The circuit is battery-powered and operation is as follows. With point L at −6V w.r.t. point E bulb 1 is driven through the forward-biased Zener diode. Bulb 2 does not light. With point L at 0V neither bulb lights.

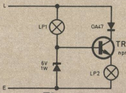


Fig. 1

With L at +6V, bulb 2 lights, the base of TR1 being driven by the very small current through bulb 1.

Finally, with L at +12V, bulb 1 is driven by the 6V supplied by the reverse-biased Zener and bulb 2 is connected to TR1 as an emitter-follower so as to receive the 6V across the Zener.

Both bulbs should be small 6V types and whilst other component types are not critical the Zener must obviously be of the correct voltage and capable of carrying the necessary current. The circuit can be reversed to accommodate a *pnp* transistor.

SEVEN-SEGMENT TO BCD DECODER

The advent of cheap l.s.i. circuits such as clock and calculator i.c.s has opened up the possibility of using these devices in more complicated circuitry; for instance the calculator i.c. could form the basis of a small computer.

The one drawback to using these i.c.s in logic systems is that their output is usually designed to drive seven-segment displays. This output is, of course, no use for feeding into other logic circuitry so the following circuit was designed to convert seven-segment outputs into standard binary coded decimal (BCD) form.

The decoder is shown in Fig. 1. This circuit is designed on the assumption that the l.s.i. chip to be used gives a 0 to 0·8V level for a segment off and an open circuit or 1·2 to 5V level for a segment on. This is of course a rather vain hope and some kind of interface circuitry will probably be required.

P. Northover,
Breaston, Derby

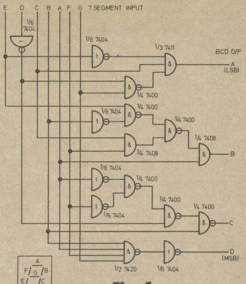


Fig. 1

SOUND SWITCH/TRIGGER

The circuit of Fig. 1 consists of three basic units, an amplifier, a monostable and a bistable. The amplifier produces a signal large enough to trigger the monostable when it receives a small voltage from the loudspeaker and transformer which form the input. TR1 is biased by the voltage divider in the emitter lead of TR2. As the amplifier is also reasonably sensitive to mains hum, the unit can be used as a touch-sensitive switch provided the transformer is first removed. Sensitivity is controlled by VR1.

The monostable prevents unwanted triggering within its own time limits which are set by varying VR2. Finally the bistable acts as a memory, remembering and maintaining TR7 in an on or off condition. D3 and C5 ensure triggering of the bistable by creating a negative pulse. The output is used as shown here to operate a mains controlling triac and lamp load.

The circuit can be made into a sound trigger by reducing the time constant of the monostable to a minimum 250ms and omitting the bistable. If beat music is now played into the loudspeaker the lamp in series with the output will be modulated in time with the beat.

N. E. Smith,
Newcastle upon Tyne.

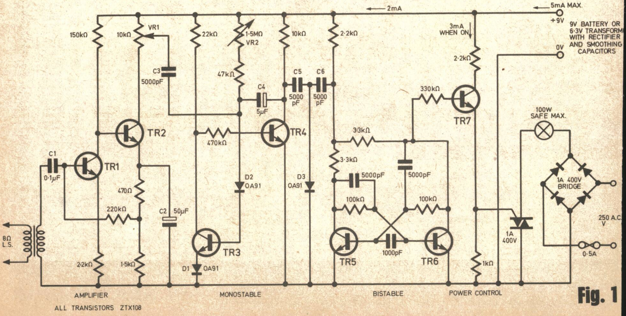


Fig. 1

CHROMASONIC electronics

Dept. 2
56, Fortis Green Road, London, N10 3HN.
telephone: 01–883 3705

INDUCTORS

Denco Maxi-Q Coils

Ferrite Rod Aerials

FRA1 Long & Medium Wave band (300pf) 86p
FRA2 Long & Medium " (500pf) 86p

Tuning Coils in two series:

Range			
1	150 khz	to	400 khz
2	515 khz	to	1.545 Mh3
3	1.67 Mhz	to	5.3 Mh3
4	5 Mhz	to	15 Mh3
5	10.5 Mhz	to	31.5 Mhz
6	30 Mhz	to	50 Mhz *
7	45 Mhz	to	78 Mhz *

* 50 pf tuning, all others based on 300 pf.

Series A Transistor – 48p each

Only available in ranges 1 to 5 inc.
4 Coils complete each range:

Blue	Aerial Coil
Yellow	R.F. Interstage
Red	Osc. Coil for 465 khz I.F.
White	Osc. Coil for 1.6 Mhz I.F.

give range number; letter 'T' and colour.

Series B Dual Purpose Coils 48p each

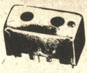
For FET or Valve Circuits
All ranges available
5 Coils complete each range:

Blue	Aerial
Yellow	Interstage R.F.
Green	R.F. plus reaction
Red	Osc. Coil for 465 khg I.F.
White	Osc. Coil for 1.6 Mhz I.F.

(Note use Red instead of White for ranges 6 & 7).

Chokes

We stock from 1 µH to 19 mH
Check levels & prices when ordering



Tuned Block Filter incorporating a Ceramic element. Pre-aligned to 470 Khz. 3db bandwidth 5Khz. Zin 100K. Zout 100K.

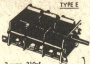
LP1175 £1.46

I.F. Transformers

IFT 13	465 khz 1st & 2nd d/tuned	65p
IFT 14	465 khz final single tuned	65p
IFT 15	10.7 Mhz d/tuned	65p
IFT 16	1.6 Mhz 1st & 2nd d/tuned	65p
IFT 17	1.6 Mhz Final s/tuned	65p
IFT 18	465 khz or 1.6 Mhz d/tuned	75p

TUNING CONDENSERS

TYPE E



3 gang 310pf
£3.99

83p
Slow Motion Drive
Ratio 6:1 Ref: 4511

TYPE C804

5pf	80p
10pf	80p
15pf	80p
20pf	83p
25pf	80p
50pf	83p
60pf	94p
75pf	94p
100pf	99p

TYPE O

365 pf £1.07
365 x 365 pf £1.30

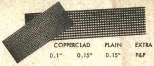
TYPE OO

208 + 176 pf with screen & trimmers
£1.48

DILECON

100pf	69p
300pf	69p
500pf	69p

VEROBOARD



	COPPERCLAD 0.1"	COPPERCLAD 0.15"	PLAIN 0.15"	EXTRA P&P
2½" x 1"	7p	7p	-	-
2½" x 3¾"	26p	21p	12p	-
2½" x 5"	30p	25p	13p	-
3¾" x 3¾"	30p	25p	-	-
3¾" x 5"	34p	34p	25p	-
17" x 2½"	90p	69p	45p	10p
17" x 3¾"	£1.21	75p	57p	10p
17" x 5"	-	-	99p	10p

D.I.P. Breadboard 4.15" x 6.15"	£1.40
VEROSTRIP (State .1" or .15")	30p
Pin Insertion Tool (State .1" or .15")	63p
Spot Face Cutter	51p
Terminal Pins in Pkts. of 50 (State .1" or .15")	22p

Details of I.C.'s; Rectifiers; Diodes; Bridges; Passive Components; LED's; Clocks; Triacs etc. can be seen on other pages and/or issues of Wireless World; Practical Wireless; and Practical Electronics.

Electrolytics

µF	4V	6.3V	10V	16V	25V	40V	63V	100V	160V	450V
1							6½p		8½p	15p
1.5							6½p			
2.2							6½p		8½p	
3.3							6½p			
4.7							6½p		8½p	17p(4uF)
6.8						6½p	6½p	8½p		
8										21p
10					6½p		6½p	8½p		
15				6½p		6½p	6½p			24p(16uF)
22			6½p		6½p		6½p	11p		
33		6½p		6½p		6½p				33p(32uF)
47	6½p		6½p	6½p	6½p	6½p	8p			25p(50uF)
68		6½p		6½p			11p			350V
100	6½p		6½p		6½p	8p	14p	25p		
150		6½p		6½p	8p	11p	14p			
220	6½p		6½p	8p	11p	14p	19p	31p		
330	6½p		8p	11p			25p	44p		
470		8p	11p		14p	20p	26p	47p		
680		10p		14p	20p	25p		59p		
1000	13p		14p	19p	22p	25p	44p	79p		
1500		18p	19p	25p						
2200		18p	24p		39p	44p	79p	149p		
3300		26p								
4700	25p			44p	68p	79p	149p	252p		
6800				75p						

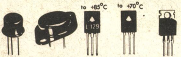
DIODES

AA119	10p	BY103	22p	0A91	8p
AA120	10p	BY105	16½p	0A200	11p
AA129	10p	BY126	16p	0A202	12p
BA100	10p	BY127	16½p	ZS120	8p
BA102	27p	BY133	23p	ZS140	25p
BA110	44½p	BY164	54p	ZS141	42½p
BA115	19p	BY176	£1.62	ZS142	32½p
BA144	20p	BY182	£1.62	ZS170	10p
BA145	22p	BY250	25½p	ZS270	11p
BA148	22p	BZX70	27p	ZS271	16p
BA154	20p	Series		ZS278	36½p
BA155	15½p	BZY88	11p	IN914	8p
BA156	16½p	Series		IN916	10p
BAX16	10p	0A47	11p	IN4009	7p
BB104	45½p	0A79	10p	IN4148	5½p
BB105B	41½p	0A81	8p	IN4448	9p
BY100	16½p	0A85	10p	IZS Series	18p
		0A90	8p		

TRANSISTORS

AC107	16p	BC213L	13p	D13V	52½p	ZTX301	13p	2N3707	12p
AC126	13p	BC214L	13p	D40N3	59p	ZTX302	17p	2N3708	10p
AC127	13p	BC268	15p	MJ480	93½p	ZTX303	14p	2N3709	10p
AC128	13p	BC407	16p	MJ481	£1.18	ZTX304	21p	2N3710	11p
AC176	15p	BCY70	17p	MJ490	£1.01½	ZTX311	10p	2N3711	11p
AC187	22p	BCY71	22p	MJ491	£1.42½	ZTX312	10p	2N3772	£2.00
AC187K	20p	BCY72	17p	MJ900	£1.42½	ZTX341	22p	2N3791	£2.55
AC188	22p	BD115	73p	MJ1000	£1.22	ZTX384	18p	2N3819	27½p
AC188K	25p	BD123	89½p	MJ2955	£1.88½	ZTX500	12p	2N3821	81p
ACY17	39p	BD124	80½p	MJ3055	£1.21	ZTX501	13p	2N3823	99p
ACY17	38½p	BD131	44p	MJ4000	£1.46½	ZTX502	17p	2N3903	16½p
ACY20	22p	BD132	52p	MJ4010	£1.95½	ZTX503	14p	2N3904	19p
AD140	48½p	BD131/2PR	£1.17	MJE340	45p	ZTX504	42½p	2N3905	23p
AD149	48½p	BD135	41½p	MJE350	97½p	ZTX531	22p	2N3906	25p
AD161	37½p	BD136	43½p	MJE2955	£1.20	ZTX550	17p	2N4058	13½p
AD162	38½p	BD201	£1.95½	MJE3055	72p	2N697	16½p	2N4059	19p
AD161/62MP	74p	BD202	£1.46½	MPF102	27p	2N706	13p	2N4062	16p
AF114	17p	BF109	74p	MPF103	40½p	2N708	16½p	2N4289	19p
AF115	17p	BF115	25p	MPF104	44½p	2N914	24½p	2N4441	85½p
AF116	17p	BF160	25½p	MPF105	44½p	2N930	22p	2N4442	£1.04½
AF117	17p	BF167	24p	MPF106	49p	2N1302	20p	2N4443	£1.42½
AF118	54p	BF173	24p	MPF111	22p	2N1303	24p	2N4444	£2.06½
AF124	32½p	BF178	28½p	MPSU06	63p	2N1304	24p	2N4871	59p
AF139	34½p	BF179	32½p	MPSU56	77p	2N1305	24p	2N4901	£1.41½
AF172	25p	BF180	32½p	OC28	49½p	2N1306	24p	2N5067	£1.07½
AF239	40½p	BF181	32½p	OC35	49½p	2N1307	27p	2N5129	16½p
ASY26	32½p	BF184	27½p	OC36	49½p	2N1308	34½p	2N5172	11p
BC107	11p	BF185	27½p	OC44	14p	2N1309	34½p	2N5191	77p
BC108	11p	BF194	15p	OC45	14p	2N1711	26p	2N5194	91p
BC109	12p	BF195	17p	OC71	14p	2N1718	£4.37	2N5295	52½p
BC117	22p	BF196	16p	OC72	14p	2N1893	52p	2N5447	16p
BC147	10p	BF197	16p	OC75	15p	2N2218	22p	2N5449	16p
BC148	10p	BF200	31½p	OC76	27p	2N2219	38½p	2N5457	46½p
BC149	10p	BF244B	27p	OC81	14p	2N2646	54p	2N5458	43½p
BC157	13p	BF262	25p	OC83	25p	2N2894	97½p	2N5459	43½p
BC158	12p	BF263	25p	OC170	27½p	2N2904	32½p	2N5485	52½p
BC159	14p	BF272	£1.19	OC171	32½p	2N2905	30½p	2N5777	48½p
BC167	17p			OCP71	£1.54½	2N2924	16p	2N6068	44½p
BC168B	11p	BFS97	23p	ORP12	65p	2N2925	18p	2N6069	51½p
BC169	12p	BFS98	20p	TIP29	53½p	2N2926G	10p	2N6070	57p
BC171	20p	BFW10	65p	TIP31	67p	2N3053	19p	2N6071	62p
BC172	17½p	BFX29	41½p	TIP31A	67p	2N3054	50½p	2N6073	67p
BC177	22p	BFX88	26p	TIP32A	79½p	2N3055	51½p	2N6075	£1.46½
BC178	22p	BFY50	22p	TIP41A	79½p	2N3375	£3.56½	2N6076	16½p
BC179	24p	BFY51	22p	TIP42A	97½p	2N3442	£1.19	2N6111	54p
BC182L	11p	BFY90	£1.09	TIS43	36p	2N3566	18p	2N6288	60p
BC183L	12p	BR100	42½p	TIS88A	36½p	2N3638	20p	3N140	99½p
BC184L	12p	BRY39	43½p	TIS91	32½p	2N3702	13p	3N141	87½p
BC187	27p	BSX20	18p	ZTX107	10p	2N3703	12p	3N153	87½p
BC204	14p	BSX21	22p	ZTX108	10p	2N3704	13p	40321	54p
BC209	14p	BSY95A	14p	ZTX109	15p	2N3705	12½p	40430	£1.39
BC212L	12½p	BU105/02	£1.95½	ZTX300	12p	2N3706	14p	40673	55p

REGULATORS



	100mA (TO-39)	500mA * (TO-3)	500mA * (SOT-32) -20°C to +85°C	0°C to +70°C	1A (TO-220)
5V	TBA625A £1.03	L005T1 (MVR5V) £1.45	L129 £1.39	TDA1405 97p	7805UC £2.42
12V	TBA625B £1.03	L036T1 (MVR12V) £1.45	L130 £1.39	TDA1412 97p	7812UC £2.42
15V	TBA625C £1.03	L037T1 (MVR15V) £1.45	L131 £1.39	TDA1415 97p	7815UC £2.42

*600mA; 500mA and 450mA respectively.

THYRISTORS SCR's

V	800mA		4A		8A	
30v	MCR102	32p	106Y	39p		
50v			106F	46p	2N4441	87p
60v	MCR103	44p				
100v	MCR104	49p	106A	48p		
200v	MCR120	51p	106B	53p	2N4442	£1.06
400v			106D	67p	2N4443	£1.45
600v			106M	£1.50	2N4444	£2.09

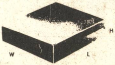
DIGITAL SWITCH

BCD encoded digital switch Reading 0 to 9. Suitable for digital clock alarm setting DVM input scaling etc.

1 to 9. £1.49 each.

ALUMINIUM BOXES

With Baseplate and screws



REF (No.)	(L)	(W)	(H)	PRICE	P&P
AB7	2¼"	5¼"	1½"	45p	15p
AB8	4"	4"	1½"	45p	15p
AB9	4"	2¾"	1½"	45p	15p
AB10	4"	5¼"	1½"	51p	15p
AB11	4"	2½"	2"	45p	15p
AB12	3"	2"	1"	38p	15p
AB13	6"	4"	2"	61p	17p
AB14	7"	5"	2½"	73p	17p
AB15	8"	6"	3"	92p	17p
AB16	10"	7"	3"	£1.05	20p
AB17	10"	4½"	3"	92p	25p
AB18	12"	5"	3"	£1.04	25p
AB19	12"	8"	3"	£1.38	25p

8% VAT INCLUSIVE PRICES

OVERSEAS CUSTOMERS DEDUCT 2/27
VAT INVOICES ON REQUEST.
P.&P. On U.K. Orders min. 15p.. Overseas Orders at Cost

PE SCORPIO Mk2 ignition system kit new from ELECTRO SPARES

* 6 OR 12 VOLT
* + VE AND - VE GROUND

Here's the new, improved version of the original PE Scorpio Electronic Ignition System – with a big plus over all the other kits – the PE Scorpio Kit is designed for *both* positive and negative ground automotive electrical systems. Not just +ve ground. Nor just —ve ground. But both! So if you change cars, you can be almost certain that you can change over your PE Scorpio Mk. 2 as well.

Containing all the components you need, this Electro Spares PE Scorpio Mk. 2 Kit is simply built, using our easy to follow instructions. Each component is a branded unit by a reputable manufacturer and carries the manufacturer's guarantee. Ready drilled for fast assembly. Quickly fitted to any car.

When your PE Scorpio Mk. 2 is installed, you instantly benefit from all these PE Scorpio Mk. 2 advantages:
★ Easier starting from cold ★ Firing even with wet or oiled-up plugs ★ Smoother running at high speed ★ Fuel saving ★ More power from your engine ★ Longer spark plug life ★ No more contact-breaker burn.

Electro Spares prices:
De luxe Kit only £10·85 inc. VAT and p & p.
Ready Made Unit £13.65 inc. VAT and p & p.
State 6V or 12V system.
Send SAE now for details and free list.

FM VARICAP STEREO TUNER

As featured in the May 1973 issue of 'Practical Electronics'. Superb Hi-Fi tuner Kit now available from Electro Spares. Including cabinet and all components – pre-set Mullard modules for R.F. and I.F. circuits. Motorola I.C. Phase Lock Loop Decoder for perfect stereo reception. No alignment needed. Guaranteed first time results – or send it back, and we'll return it in perfect order (for a nominal handling charge). Electro Spares price **only £28.50 inc. VAT and p & p.**

'GEMINI' STEREO AMPLIFIER

A superb unit with a guaranteed output of 30 watts RMS per channel into 8 ohms. Full power THD is a mere 0.02%, and frequency response is —3 dB from 20 Hz to 100 kHz into 8 or 15 ohms. Electro Spares have already sold 100s and 100s of these Kits. Get yours now! Depending on your choice of certain components, the price can vary from **£50 to £60 inc. VAT and p & p.**

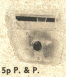
★ All components as specified by original authors, and sold separately if you wish.
★ Full constructional data book with specification graphs, fault finding guides, etc. 55p plus 9p postage.
★ Price List only. Please send S.A.E. (preferably 9 × 4 minimum) for full details.

ELECTRO SPARES

The Component Centre of the North
288 ECCLESALL RD., SHEFFIELD S11 8PE (D)
Tel: Sheffield (0742) 668888

4¼in × 3¼in METER. 30μA, 50μA or 100μA, **£3·85.** 11p P. & P.

TAPE RECORDER LEVEL METER



500μA, **70p.** 5p P. & P.

CARDIOID DYNAMIC MICROPHONE

Model UD-130. Frequency response 50–15,000c/s. Impedance Dual 50K and 600 ohms, **£6·55.** 11p P. & P.

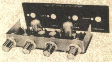
42 × 42mm meters 100μA, 500μA, 1mA, 500mA, **£2·76.** 11p P. & P.

60 × 45mm meters 50μA, 100μA, 500μA and 1mA VU meter, **£2·92.** 11p P. & P.

Edgewise meters 90mm × 34mm 1mA, **£3·40.** 11p P. & P.

MULTI-METER

Model 200H 20,000 ohm/volt, **£7·65.** 15p P. & P.



3 WATT STEREO (1½ + 1½) PER CHANNEL AMPLIFIER

£4·30. 10p P. & P.

All above prices include 8% V.A.T. LARGE S.A.E. for List No. 11. Special prices for quantity quoted on request.

M. DZIUBAS
158 Bradshawgate • Bolton • Lancs. BL2 1BA

ENGINEERS FREE YOURSELF FOR A BETTER JOB WITH MORE PAY!

Do you want promotion, a better job, higher pay? "New Opportunities" shows you how to get them through a low-cost home study course. There are no books to buy and you can pay-as-you-learn.

This helpful guide to success should be read by every ambitious engineer. Send for this helpful 76 page FREE book now. No obligation and nobody will call on you. It could be the best thing you ever did.

CUT OUT THIS COUPON

POST NOW

CHOOSE A BRAND NEW FUTURE HERE!

Tick or state subject of interest. Post to the address below.

Practical Radio and Electronics (Technatron) ☐
Electronic Engineering ☐
Television Maintenance and Servicing ☐
General Radio and TV Engineering ☐
Radio Servicing, Maintenance and Repairs ☐

C. & G. Radio, TV Electronics, Mechanics ☐
Radio Amateurs ☐
Practical TV ☐
Colour Television ☐
Computer Electronics ☐
C. & G. LI Radio TV Servicing cert. ☐
Post Master General 1st & 2nd class certs. ☐
C. & G. Electrical Engineering Practise ☐

C. & G. LI Installations and Wiring ☐
General Electrical Engineering ☐
Society of Engineers (Electrical Engineering) ☐
Electrical Installations and Wiring ☐
C. & G. Electrical Technicians (Primary) ☐
C. & G. Telecommunications ☐

To **ALDERMASTON COLLEGE**
Dept. EPE05, Reading RG7 4PF

NAME (Block Capitals Please) ……
ADDRESS ……
POSTCODE ……
Other subjects …… Age ……
Accredited by C.A.C.C. Member of A.B.C.C.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

A "DIVIDE BY ANYTHING" COUNTER SYSTEM

This counter system was originally devised for frequency synthesis for an amateur radio transmitter but it can be modified simply to produce any "divide-by" ratio and should accept any input frequency up to the limit (about 18MHz) set by the counting flip-flops (SN7493's).

The circuit Fig. 1 is based on a simple binary counter system which is reset after reaching a predetermined count. By way of example, Fig. 1 shows a count of eleven, this being achieved by connecting the 8, 2 and 1 outputs of the binary counter to the reset gate.

The circuit operates as follows. The binary counter operates in normal fashion until a count of eleven (binary 8+2+1) is reached. At this instant (point X on the timing diagram, Fig. 2) the reset gate is satisfied and the reset signal sets the J-K flip-flop, FF. The FF 'Q' output resets the counter to zero so that the counter contains the value eleven only for a few nanoseconds whilst the FF is triggering.

The $\bar{Q}$ output of FF sets the flip-latch (FL) which allows gate A to reset the FF when the input next goes high (point Y on the timing diagram). Finally, when the input next goes low (point Z on the timing diagram) the FL is reset and the counter recommences counting from zero. Thus, one output pulse from the FL is obtained for eleven input pulses, i.e. a divide-by-eleven arrangement.

To change the "divide-by" ratio, it is only necessary to connect the appropriate counter outputs to the reset gate, and if a multiway switch is used this ratio can be changed at will.

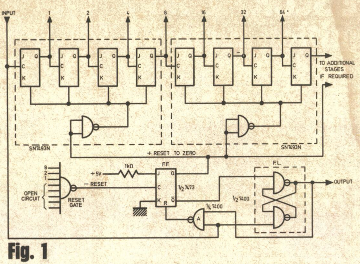


Fig. 1

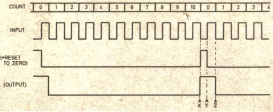


Fig. 2

Suppose we wish to divide the 50Hz mains frequency by 3000 to obtain 1 pulse per minute, for timing purposes. Twelve counter stages are needed with outputs 2048, 512, 256, 128, 32, 16 and 8 connected to the reset gate. The cost of such a system 3 × 7493, 1 × 7430, 1 × 7400, $\frac{1}{2}$ × 7473 is roughly equivalent to a fixed divide system using a 7492 (÷ 1000).

For a low-cost system the keen experimenter could try reject 7493's, available at 55p for five. A sample test of 25 yielded a 50 per cent usage.

C. J. Brewitt,
Plymouth,
Devon.

TTL OSCILLATOR

As can be seen from the circuit diagram of Fig. 1 this TTL oscillator uses but one gate, albeit a 7413 Schmitt trigger, instead of the more common three gates in a self oscillating ring.

The basic circuit operation is as follows: At switch on C1 is discharged and will begin to charge positively as a result of the gate input current and the current flowing through R1 and VR2 from the gate output high voltage. The voltage against time curve for C1 will be a close approximation to an exponential and when it reaches the positive going input threshold voltage the gate output will switch low.

C1 will then begin to discharge towards a nominal 0·3V through R1, VR2 and the gate output transistor. When the voltage on C1 reaches the negative-going input threshold the gate output will switch high allowing C1 to charge positively again, and so the cycle repeats in sustained oscillation.

The voltage appearing at the positive side of C1 will have the general form as shown in Fig. 2, the output waveform being as shown below.

The unused half of the 7413 may of course be used as a 4 i/p NAND gate elsewhere in the system if required.

T. C. Rogers,
Ontario, Canada.

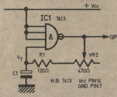


Fig. 1

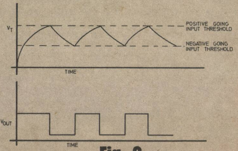


Fig. 2

PATENTS REVIEW...□□□

COMMON PATENT?

With a referendum on our entry into the Common Market now due in the not too distant future, manufacturers in the electronics field may like to consider how EEC industrial property law affects their rights under British law.

It is only now becoming widely understood that the Treaty of Rome, which governs the EEC, can often override established national laws. Traditionally, the layman seeks legal advice from an expert, who gives that advice on the basis of his past experience with precedents or judgments handed down by courts over recent decades. Unfortunately, because the Luxembourg European Court has had occasion so far to hand down only relatively few judgments, legal experts can seldom give laymen the crisp and straightforward advice that they seek. The situation is further confused by the fact that the Treaty of Rome contradicts itself over the value of *national* industrial property laws in the Common Market.

To reduce the problem to words of one syllable, Articles 30, 85 and 86 of the Treaty of Rome make it clear that there shall be no restrictions or barriers to distort free trade between separate countries in the EEC. The whole point of industrial property rights (patents, trade marks and design registrations) is, however, to create barriers to distort free trade! So the Treaty (in Articles 36 and 222) specifically exempts industrial property rights of this type from its other Articles. Which articles of the Treaty, therefore, is a manufacturer to rely on?

It may help readers to have a brief résumé of the few hard facts that have now been established and how they *may* apply to everyday marketing in electronics.

One reported case has shown that under certain special circumstances the European Court will allow the same trade mark to be used on the same goods in the same EEC state, although those goods originate from different companies. What this coud mean is that under certain circumstances a range of components, such as transistors, made under a brand name by one company could be sold alongside an exactly similar range of components, under the same brand name, but originating from an entirely different manufacturer.

PRICE CONTROL

Whatever the Treaty may require in terms of harmonised price control between member states of the Community, the same goods sell at widely differing prices throughout Europe. Spirits such as brandy and whisky are taxed by different amounts in different countries and goods such as domestic electronic equipment are usually cheaper in the UK than anywhere else. For instance, although most Philips' audio gear is imported both into the UK and France, it costs about 50 per cent more in France than here. Likewise, Trio gear, also imported into both countries, costs about twice as much in France. BASF (German) tapes are around 50 per cent more expensive in the French shops than ours.

The crunch is that where a price differential exists between two EEC states, a manufacturer holding national patents will be powerless to stop a third party opportunist bulk buying a patented product in the country where it is cheap and selling it at a slightly higher price to make a profit in the country where it is much more expensive. If a manufacturer has patents in France and England and charges more for his amplifier in France than in England, there is probably nothing that he can do to prevent an entrepreneur buying up those amplifiers in bulk in England and selling them at a half-way price to make a killing in France. Of course, ordinary national laws, if they were not affected by the Treaty of Rome, would usually enable the manufacturer to use his patents to block such sales.

Some inventors with really important new ideas are now being advised that they should file patent applications in all nine EEC countries to be sure of solid protection in any of them. This advice is, however, probably incorrect, because the Commission itself, in a written answer (Official Journal of the Communities, Vol. 17, C90, July 29, 1974, p. 10) has said otherwise. Although the words of the Commission answer are rather tortuous, they add up to a confirmation that an inventor holding a patent in only one, or only a few, of the EEC states should be able to use his patent to prevent the importation of infringing articles made elsewhere in the EEC without his permission.

What this means in practice is that existing laws hold good and although a manufacturer with a patent on a component or piece of equipment in only this country will not, of course, be able to prevent a competitor making the article in another EEC country (which the competitor can do legally if there is no patent there), he *will* be able to stop him importing it into this country for sale. This reassurance from the Commission will be welcomed by manufacturers and inventors with a budget far too low to cover the cost of filing patents in all the EEC countries.

However, it is far from certain what will happen if a British electronics manufacturer, through choice or lack of hard cash, patents a new development in this country only but manufactures it elsewhere in the EEC. He is of course free to do this, but if his wares are cheaper on the Continent (which is possible if he is in a very competitive specialised market there), can he prevent an opportunist buying up those cheap wares and importing them into this country for open sale at under the normal British price? No one is yet sure of the answer to this question.

INFORMATION OFFICE

British researchers and manufacturers with questions like these should not forget that there is in this country a European Communities Commission Information Office. The address to write to is 20 Kensington Palace Gardens, London W8 4QQ.

One function of the Office is to help us understand the Treaty of Rome and what it means to us, also businessmen with an industrial property problem should try putting it to the Commission. There is no guarantee that they will know the answer; but if they do not, then who in the EEC does?

Copies of Patents can be obtained from the Patent Office Sales, St. Mary Cray, Orpington, Kent. Price 25p each

Readout—

A SELECTION FROM OUR POSTBAG

Readers requiring a reply to any letter must include a stamped addressed envelope. We regret that we cannot answer any technical queries on the telephone.

Excellent platform

Sir—I apologise sincerely if my letter (*Readout*, Dec. '74) caused any upset. In replying, Mr Shaw (February issue) was of course right; 1974 was marked by hundreds of others like me acquiring a synthesiser. This is what I intended to imply and it serves me right for being facetious that the meaning did not come across.

To Mr Shaw's credit is that he gave us more than mere synthesiser circuits; the clarity of his explanations gave the "P.E. Synthesiser" series a terrific educational inuendo. Credit to P.E. also; being the first to publish synthesiser circuits in such a comprehensive way, the series must have been an all-time giant in amateur constructors' projects.

Mr Shaw, however, also highlights what will be the real breakthrough so far as synthesisers are concerned; the recognition of a work of musical power. In agreement with Mr Watson (February), I see this as a work of the ilk of "Silver Apples . . ." or "Touch" (Substnick rather than Kubrik's ninth symphony (original version clockwork, new version electronic) by Walter Carlos.

To Mr Pointon (also February). If I were carried away by "quite a few red herrings" in his article, they had to be there to carry me away. I still contend that too much is being made out of the synthesiser. One need look no further than such electronic classics as "Kontakte" and "Telemusik" (Stockhausen) to see that electronic music was doing nicely, thank you very much, before Robert Moog set up production.

But I certainly must praise Mr Pointon's efforts in presenting so broad a view of musical history so well in such a small space, particularly when it comes to the complexities of twentieth century music. Anyone who has attempted any research in depth will appreciate the difficulties involved. Periodicals such as "Die Reike" (covering German-influenced work in the fifties and sixties) are not the easiest to read.

I am sure many readers who have carried out such research would agree that Mr Pointon's articles provide an excellent platform from which to launch for the lesser initiated. Given choice, I would read them in preference to many others. So, Mr Pointon, we look forward to more . . . and by the way, can I borrow your 24-, or is it 32-track recorder sometime? Thanks!

Ivor Stuart-Colwill,
London, S.W.16.

Time and motion

Sir—I have been for many years a regular reader of PRACTICAL ELECTRONICS, and was particularly interested in the February issue's article on transistorising battery driven electric clocks, because I have gone into this in some detail for a number of years, and built several successful units, for both balance clocks such as the Jaeger car clock, the one I think Mr Cooper had in mind, and for pendulum clocks such as the Bulle.

I was disturbed to find that the method and circuit suggested by Mr Cooper (if I have understood the article correctly) seems to destroy one of the most important design features of such clocks—their inherent automatic compensation for varying supply voltages, vital for car clocks where the battery voltage varies between 12 and 15 volts, and for certain wear-and-tear defects in the movement. The author's very last sentence seems to me to be the most revealing.

The reason for modifying these clocks is to avoid arcing at the contacts and the pitting and wear that follows, so that the clock behaves as if it had perpetually clean and new contacts. This arcing cannot be avoided otherwise, owing to the relatively high self-inductance of the coil; it is extremely minute and generally quite invisible, but its presence can easily be detected by a radio brought close to the clock, when the r.f. signal radiated is heard as a regular "click".

The compensating action is best understood by noting that the balance has to swing through a minimum arc so that each tooth of the escapement may be cleanly released and the next tooth impulsed. An extra amount of swing is allowed for, to take care of random variations in supply and possible slight irregularities in the machining of the escapement. A maximum swing of about 360° is normal.

Suppose now that the arc of swing tends to decrease owing to fall in supply voltage, inadequate contact, or increasing friction; the "contacts closed" time will increase, and therefore the magnetic field. Consequently the balance will receive more drive and the arc will increase. If on the other hand the arc tends to increase, as with a rise in supply voltage, the reverse takes place. Thus the balance will maintain a broadly constant arc irrespective of variation in the conditions.

The problems about the circuit proposed is that it appears to abolish the vital dependence on contact time; once any sort of contact is made, full current flows for a fixed time dependent on a given CR combination and Mr Cooper actually says that the period for which the contacts are closed is not important. If this current is sufficient to maintain a proper arc on a low voltage, it will be too great on a higher voltage; the swing will increase to an unacceptable degree and "overbanking" will take place.

The balance will swing so far in either direction that at the end of one or both swings the escapement will strike a mechanical obstruction such as a guard pin, or in the case of the Jaeger car clock, the end of the helical escapement channel on the balance staff. Apart from anything else, the balance will be bounced back on its next swing sooner than it should be, and the clock will gain. This is just what the author says could be expected.

A far more serious consequence will be rapid wear of escapement and pivots. "Overbanking" can be heard, if at the end of one swing only as "tick-a-tick-a-tick". This cannot be cured as suggested by altering the normal regulator acting on the hairspring effective length (the mean time of the overbanked swing can be reduced so that the clock will cease to gain, but at the cost of ruined timekeeping) because if for any reason overbanking stops for a while, the clock will loose heavily. If the current supply to the clock is as it should be, the timekeeping cannot possibly be affected.

What these clocks need is a transistor as an instantaneous inertia-less relay, whereby the clock contacts only break the minute base current in a non-inductive circuit, while the power to the clock is supplied by the collector circuit. In this way the compensation function is preserved unimpaired. This can be done very simply with far fewer components (one transistor, one resistor, and a protective diode across the clock coil) see Fig. 1. It may be thought wise to protect the transistor against any accident by adding two more resistors, but I have not found this necessary.

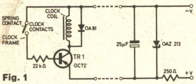


Fig. 1

The clock should be run out of its case on the bench for a day or so and the balance swing watched, in the horizontal orientation it will have when installed, from a power supply of 8 dry cells giving a voltage of about 12·8 volts. The movement will run itself in again and its efficiency may well increase, particularly if advantage has been taken of the dismantling to clean it and to oil the moving parts with watchmaker's oil. It may therefore be necessary, if the swing increases to over 360°, to increase the value of the base resistor somewhat.

A great improvement is to be had by stabilising the power supply. The circuit suggested in the article is rather inadequate, since while it supplies a power reservoir to tide the clock over momentary large falls in voltage such as when the starter is operated, it offers no protection against surges of high voltage. An improvement is the use of a normal Zener diode stabiliser, which will maintain a constant supply voltage, whatever happens to the battery circuit.

Since these clocks will run perfectly well on 11 volts, or even less, the diode should be selected for this voltage, and should be of adequate wattage, since it will be passing some current most of the time and must not overheat—at least 1 watt.

The value of the series resistor should be found by temporarily substituting a 5,000 ohm wire-wound potentiometer, then connecting up the clock, and reducing the resistance from maximum till the clock continues to run; place a voltmeter across the smoothing capacitor, and the reading will be found to fluctuate in time with the clock pulses. Reduce the resistance till the voltage reading remains constant, showing that supply just balances demand. Then measure the resistance of the potentiometer at this setting and substitute a 1 watt fixed resistor of that value.

It is not advisable to mount any components inside the clock case, with the possible exception of the protective diode across the coil, as space is generally very limited and damage might unwittingly be done when screwing the movement back into the case. It is better to mount all the components on to a strip of Veroboard which can be suspended in the supply wires and protected by a wrapping of polythene film.

S. A. R. Guest,
Cornwall.

We hope to publish the author's reply next month

Millivoltmeter

Sir—Constructors of the A.C./D.C. Millivoltmeter (P.E. February 1975) may be interested in a couple of points concerning a.c. operation of the instrument.

The circuit shown with the article can accurately measure symmetrical square wave alternating voltages, but certain qualifications must be borne in mind in measuring sinusoidal voltages. For pure sine wave voltages or currents, two main types of measurement may be distinguished, the average (E_{av}, I_{av}) and the root mean square (E_{rms} etc) which is often abbreviated to a.c. The former is analogous to the effect of d.c. on a moving coil meter and the latter to resistor power dissipation.

If it is wished to measure r.m.s values with the circuit indicated, the following correction should be applied:

$$E_{rms} = \text{scale reading} \times 1{\cdot}11$$

A second point arises in the extent of scale deflection for sinusoidal measurements. For full scale deflection to occur 11V r.ms must be applied to the bridge rectifier; this implies a peak to peak swing of

$$11 \times 2\sqrt{3} = 31 \text{ volts}$$

With the power supply voltages used for the amplifier, a linear input/output response may not be expected above

$$\frac{2 \times 12}{31} = 0{\cdot}77 \text{ of full scale.}$$

Dr J. H. Wood.
Bingley.
W. Yorks.

Dr Boole vindicated

Sir—May I thank Messrs. Thompson, Tozer, Dickson and Everett for their amusing and extremely helpful remarks in *Readout*, March 1975. The two salient points which emerge are, firstly, that Boolean Algebra deals solely with the presence or absence of things, and secondly that the sign = should be read as "if . . . then".

Dr Boole would have read his equation A + A.B = A as, "If A is present, or both A and B are present, then A is present." This, put into breakfast-time English, says that if there is an egg on a plate, whether there is bacon with it or not, there is still an egg on the plate.

This, no one can dispute, but if I am served breakfast again by the same waitress, who may not have read this correspondence, I shall play safe and order cornflakes.

R. Parfitt,
Croydon

BACK NUMBERS WANTED

Anyone who can supply the undermentioned are asked to communicate directly with the reader:

We regret that back numbers of Practical Electronics can no longer be supplied. We will try to publish announcements of readers' requirements (without a guaranteed date) free of charge.

April, May 1974
Mr. H. Coates, 60 Ounsdale Road, Wombourn, Wolverhampton.

September 1970
Mr. B. Dickson, 17 Craigrownie Gardens, Kilcreggan, Dunbartonshire, G84 0HY.

January 1970, September 1972, November 1973
Mr. B. Fernandez, 8 Munchen 83, Kafkastr. 52, W. Germany.

February, April, May, July, October, November, December 1973, February 1974
Mr. J. Matthews, 39 Maes-y-Gornel, Rhos, Wrexham, Clwyd.

November 1973
Mr. D. Prestage, 47 Knighton Road, Otford, Kent TN14 5LD.

April, May, June, July 1971
Mr. R. Stannard, B.I. House, Marlborough College, Wilts.

May 1974
Mr. R. Gilyard, 15 Barfield Crescent, Leeds LS17 8RU

March, April 1974
Mr. M. S. Evans, 33 House Farm Road, Alverstoke, Gosport, Hants.

March, December 1973, February, March, April 1974
Mr. E. D. Gilpin, Dept. of Agriculture for Northern Ireland, Fisheries Research Laboratories, The Cutts, Coleraine, Co. Londonderry.

January, June, August 1968
Lee Wing Hong, 2/F Block C, Lion Mansion, Po Kong Village Road, Wong Tai Sin, Hong Kong.

October 1972
Mr. M. A. Telford, Officers' Mess, RAF Chivenor, Barnstaple, North Devon.

January, February 1973
Mr. J. Fillis, 42 Upton Road, Upton, Torquay, Devon.

March, November 1972
Mr. J. B. Hansen, 44 St Christopher's Drive, Romiley, Stockport, Cheshire.

November, December 1973, March 1974
Mr. R. A. Yeomans, New Park Drive, Kilkenny City, Ireland.

October 1973, February 1974
Mr. M. Zammit, Dolpin House, Felice Street, Zabbar, Malta.

February to August 1973
Mr. E. Moxnes, 7170 Aa i Aafjord, Norway.

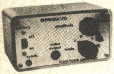
BI-PRE-PAK

Bargains in Semi-Conductors, components, modules & equipment.

BARGAINS FROM OUR FREE CATALOGUE

6th edition. 20 large pages filled with real bargains in transistors, I.C.s, components, equipment, etc. Send large S.A.E. with 6p stamp for your FREE copy by return. Meanwhile, for prompt delivery order from our ad. this month NOW.

X-HATCH GENERATOR MK.2



Rotary selector switch provides choice of four patterns—essential for colour TV alignment. Featuring plug in IC's and a more sensitive sync. pick-up circuit. The reinforced fibre-glass case is virtually unbreakable—ideal for the engineer's toolbox—only measures 3in × 5½in × 3in. Operates from three U-2-type batteries (extra).

Ready built unit only **£9·93**

Complete kit **£7·93**

PLASTIC POWER TRANSISTORS

40 WATT SILICON

Type No.	Gain	VCE	Polarity	Price
40N1	15	15	NPN	**20p**
40N2	40	40	NPN	**30p**
40P1	15	15	PNP	**20p**
40P2	40	40	PNP	**30p**

90 WATT SILICON

Type No.	Gain	VCE	Polarity	Price
90N1	15	15	NPN	**25p**
90N2	40	40	NPN	**35p**
90P1	15	15	PNP	**25p**
90P2	40	40	PNP	**35p**

TRANSISTOR PACKS—ALL AT 50p EACH

TESTED AND GUARANTEED

B79	4	IN4007 Sil. Rec. diodes. 1,000 PIV 1 amp. plastic
B81	10	Reed Switches, 1in long ⅛in dia. Highspeed P.O. type
H35	100	Mixed Diodes, Germ. Gold bonded, etc. Marked and Unmarked
H38	30	Short lead Transistors, NPN Silicon Planar types Ex-equipment
H39	6	Integrated circuits 4 gates BMC 962, 2 flip flops BMC 945
H41	2	BD131/BD132 Complementary Plastic Transistors
H65	4	40361 Type NPN Sil. transistors TO-5 can comp. to H66
H66	4	40362. Type PNP Sil. transistors TO-5 can comp. to H65

UNMARKED AND UNTESTED

B1	50	Germanium Transistors PNP, AF and RF
B66	150	Germanium Diodes Min. glass type
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202
B86	100	Sil. Diodes min. 1N914 glass equivalent to 1N4148
H20	20	BY126/7 Type Silicon Rectifiers 1 amp plastic. Mixed volts
H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can
H67	10	3819N Channel FET's plastic case type

OVER A MILLION TRANSISTORS IN STOCK—All most-needed types MARKED — TESTED — GUARANTEED—SEE CATALOGUE

TO CLEAR

Hundreds of various portable transistor radio chassis with FM and AM tuning. Ideal for experimenters. All in going order, but no instructions, or tuning drives. A cheap way to make a radio set.

£1 Each

MAINS TRANSFORMERS

Type A—18V/1A (suit SS. 103) **£1·50.**
Type B—25V/2A (suit SS.110) **£2·00.**
Type C—30V/2A (suit SS.140) **£3·25.**
Bridge Rectifiers: Type A **27p**; Types B & C **38p.**

ELECTRONIC IGNITION KIT

Easy to make and fit. With instructions. **£7·50**

TERMS OF BUSINESS

V.A.T. Prices shown do not include V.A.T. Please add 8% to total value of your order including postage. No V.A.T. on overseas orders.

POSTAGE Except where stated, add 15p for postage and packing in U.K. Overseas—add £1, any difference being charged or refunded.

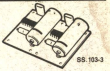
PAYMENT Cash with order, Cheque or money order. Minimum value—£1. You can also pay by ACCESS.

IMPORTANT—*Every effort is made to ensure accuracy of prices and description at time of preparing this advertisement and going to press. Prices are subject to alteration without notice.*

CHALLENGING VALUES!

Stirling Sound

STIRLING SOUND AUDIO MODULES come to you as basic units assembled on P.C.B.s enabling you to add required components in layouts of your own choice. Modules are tested and boxed before despatch and include well printed instructions.



SS.103-3

AMPLIFIER MODULES

Pre-amplifiers; tone control

SS.100 Active tone control unit to provide bass, treble, balance and volume controls **£1·60**

SS.101 Pre-amp for ceramic cartridge, tape and radio **£1·60**

SS.102 Pre-amp for low output magnetic cartridge tape and radio. With R.I.A.A. correction ±1dB at 1kΩ **£2·25**

SS.105

POWER AMPLIFIERS

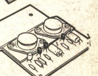
SS.103 Compact I.C. amp. with 3 watts R.M.S. output. Operating voltage 6–22. Size 3in × 2in. **£1·75**

SS.103–3 Stereo version of above using one I.C. on each channel **£3·25**

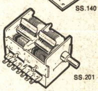
SS.105 A compact and useful all-purpose amplifier which will run excellently on a 12V supply. With 5 watt output, two make a good stereo amp. Size 2½in × 1¾in. **£1·95**

SS.110 Similar in size to SS.103 but with a 10 watt output. Ideal for many domestic and small-size P.A. applications. Operates from 26–32V. **£2·40**

SS.140 Excellently designed 40 watt R.M.S. (into 4 ohms) hi-fi amplifier. S/N ratio better than 75dB. T.H.D. better than 0·2%. Power requirements—45V d.c. With 0·15in centre edge connections. Two can be bridged to give 80 watts R.M.S. into 4 ohms **£3·60**



SS.140



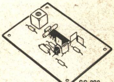
SS.201

TUNER MODULES

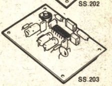
SS.201 Ganged tuning condenser with accurately engineered slow-motion drive in rugged housing. Excellent sensitivity. Tunes 88–108MHz. With A.F.C. facility. Operates from 6–16V **£6·25**

SS.202 I.F. stage (with I.C.). Pre-tuned. A.F.C. connection. Operates from 4·5–14V **£5·25**

SS.203 Stereo Decoder. Designed essentially for use with SS.201 and SS.202, this module can also be used on most mono F.M. tuners. A L.E.D. may be attached. Operating voltage 9–16V d.c. **£5·62**



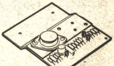
SS.202



SS.203

POWER SUPPLY STABILISER

SS.300 Add this to an unstabilised supply (say typically 45V output) to obtain a steady powerful working output adjustable from 12 to 60V. Essential for your audio and special systems. Money saving and very reliable. **£3·25**



SS.300

- * ALL MODULES TESTED AND GUARANTEED
- * WITH WELL PRINTED INSTRUCTIONS
- * FULL RANGES OF ANCILLARY COMPONENTS AVAILABLE—SEE FREE CATALOGUE

Have you had your FREE CATALOGUE?

To BI-PRE-PAK, 222–224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX

Please send ……………………………………………………

for which I enclose ……………………………………… inc. V.A.T.

NAME ……………………………………………………

ADDRESS …………………………………………………… PE5

BI-PRE-PAK LTD

Co Reg No 820919
222 224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX SS0 9DF.
TELEPHONE: SOUTHEND (0702) 46344.

WRITE ORDER SEPARATELY AND ATTACH COUPON IF NECESSARY

TRANSISTORS

AC107	0·16	BC159	0·13	C111E	0·55	T6217	0·30
AC126	0·13	BC171	0·16	CV5441	0·27	V405A	0·25
AC127	0·13	BC172	0·16	CV7464	0·10	V10-50	0·40
AC128	0·12	BC173	0·16	CV7594	0·25	Y25	0·10
AC138	0·20	BC184	0·18	CV7648	0·30	Z116	0·75
AC141	0·20	BC208	0·12	CV8762	0·40	ZTX107	0·12
AC142	0·20	BC209	0·13	MDS33	0·30	ZTX302	0·17
AC153	0·22	BC212L	0·14	ME4102	0·12	ZTX502	0·17
AC176	0·15	BC301	0·30	NKT162	0·25	2G106	0·21
AC176	MP	BC336	0·15	NKT164	0·25	2G306	0·44
AC128	0·25	BC337	0·15	NKT212	0·20	2G345A	0·18
AC178	0·25	BCZ11	0·28	NKT221	0·17	2G402	0·25
ACY17	0·28	BD131	0·40	NKT224	0·15	2N526	0·46
ACY19	0·22	BD132	0·40	NKT270	0·15	2N697	0·15
ACY20	0·22	BD131	MP	NKT278	0·15	2N715	0·35
ACY21	0·22	BD132	0·75	OC22	0·50	2N726	0·25
AD161	0·38	BD139	0·60	OC28	0·50	2N753	0·55
AD162	0·38	BD140	0·60	OC35	0·46	2N1304	0·19
AD161	MP	BF167	0·24	OC36	0·55	2N1305	0·19
AD162	0·75	BF194	0·12	OC45	0·14	2N1309	0·25
AF115	0·26	BF196	0·15	OC70	0·11	2N1754	0·20
AF116	0·26	BF197	0·16	OC71	0·11	2N2484	0·30
AF178	0·50	BF274	0·39	OC72	0·15	2N2926	0·14
ASY52	0·22	BFX29	0·30	OC81	0·17	2N3055	0·50
BC107	0·09	BFX85	0·33	OC201	0·30	2N3702	0·12
BC108	0·09	BFY50	0·20	OC445K	0·25	2N3703	0·12
BC109	0·09	BFY51	0·20	SGS26920	0·15	2N3704	0·14
BC142	0·30	BFY52	0·20	SGS26942	0·14	2N3710	0·10
BC143	0·30	BFY81	0·65	SGS26949	0·15	2N3711	0·10
BC147	0·10	BSY38	0·20	SGS27022	0·18	2N3713	1·20
BC148	0·10	BSY39	0·20	SU203	0·65	2N4047	0·25
BC149	0·10	BSY40	0·31	TK100	0·75	2S322	0·46
BC157	0·11	BSY41	0·31	TIS90M	0·33	2S712	0·46
BC158	0·11	C111	0·50	TIS91M	0·33	2S745	0·46

DIODES

				OA202	0·08	IN4003	0·05
AA119	0·06	BY100	0·16	IN34A	0·08	IN4004	0·06
2 AALL9	0·18	BY127	0·16	IN202	0·10	IN4005	0·07
AAZ15	0·11	BY164	0·55	IN252	0·10	IN4006	0·08
BA90	0·10	BYX38 300	0·46	IN984B	0·10	IN4007	0·09
BA111	0·20	BYZ13	0·28	IN1124	0·10	IN4151	0·06
BA112	0·20	BZY95	0·15	IN3064	0·12	IN4148	0·04
BAY31	0·15	OA81	0·08	IN4001	0·05	IN4244	0·07
BAY74	0·16	OA200	0·07	IN4002	0·05	IS3036A	0·15

ZENER DIODES

400mW 2-33V	all 0·07 each	BZY91 C12 STUD TYPE	3·00
1W 1 5 2-33V	all 0·16 each	BZY91 C33R STUD TYPE	3·00
		BZY91 C43 STUD TYPE	3·00

TESTED S.C.Rs

50 PIV 3A TO-66 CASE	0·25
100 PIV 3A TO-66 CASE	0·25
200 PIV 3A TO-66 CASE	0·30
400 PIV 3A TO-66 CASE	0·40
600 PIV 3A TO-66 CASE	0·50
800 PIV 3A TO-66 CASE	0·60

ZENER DIODES

CV7204 11V STUD TYPE 0·60

THYRISTOR BT 109

CON BRI 0·75

OPTOELECTRONICS

ORP 12 0·48 OCP 71 0·48

LOGIC I.C.s

TYPE			
MC930	0·15	MC946	0·14
MC932	0·15	MC948	0·25
MC933	0·15	MC962	0·15
MC944	0·16	MC9093	0·40
MC945	0·30	MC9097	0·40

74 SERIES I.C.s

SN741	0·45	SN7400	0·18
SN7400	0·18	SN7405	0·18
SN7401	0·18	SN7406	0·39
SN7402	0·18	SN7490n	0·74

JETs SUPER BARGAIN PACKS

No	Qty	Contents	Price
J1	1	Pre-amp component kit plus data	0·55
J2	3	Transistors AF115 new and marked	0·55
J3	10	Transistors Y25 new and marked	0·55
J4	4	Transistors 2N726 new and marked	0·55
J5	8	Zener diodes top hat type 75 volt	0·55
J6	75	Diodes mixed new and marked	0·55
J7	50	Metres con/wire mixed colours	0·55
J8	25	Metres con/wire, 4 metres solder	0·55
J9	100	Resistors hi/stab ¼W mixed values	0·55
J10	100	Resistors hi/stab ¼W mixed values	0·55
J11	45	sq inches approx. copper clad veroboard	0·55
J12	250	Resistors mixed values	0·55
J13	100	Polystyrene capacitors 10pF to 300pF	0·55
J14	100	Capacitors miniature mixed values	0·55
J15	5	Terminal blocks 12 way brand new	0·55
J16	4	Toggle switches assorted	0·55
J17	10	Switches 5 push to make off/on	0·55
J18	12	Standard crocodile clips	0·55
J19	12	Screwdrivers 5 inches in length	0·55
J20	1	Pack nuts and bolts, solder tags, etc., etc.	0·55
J21	2	Solenoids 24 volt pull ex-new equipment	0·55
J22	20	Volume controls mixed lin and log	0·55
J23	75	Syn/rubber grommets mixed sizes	0·55
J24	1	Component board full BC107-8-9, etc	0·55
J25	20	Screw on rubber feet ½ inch dia. approx	0·55
J26	1	Pack marker sleeve mixed rod	0·55
J27	5	Lengths of ferrite rod	0·55
J28	20	Tag strips assorted lengths	0·55
J29	4	Micro switches brand new	0·55
J30	2	Sets of 5 bank push switches new	0·55
J31	20	Pre-set pots lin and log mixed	0·55
J32	20	Capacitors can type mixed	0·55
J33	50	Ceramic plate capacitors mixed	0·55

BONANZA
½ MILLION CAPACITORS

WE CANNOT NAME THE WELL KNOWN MAKER DUE TO THE LOW PRICE. THEY ARE OF THE VERY LATEST DESIGN AND TYPE. 100 OF MIXED VALUES AND TYPES VALUED AT OVER £5. YOURS FOR ONLY £1·50. NO MORE TO PAY (WHAT A BARGAIN).

Electrolytics 6·8µF at 40V, 100µF at 63V, 680µF at 16V, etc.

Polyester 1500pF at 400V, 0·0015pF at 400V, 0·0068pF at 400V.

Miniature Metallized Film 0·22nF at 250V, 47nF at 250V, etc.

Ceramic Plate 82pF at 100V, 22000pF at 40V, 4700pF at 40V, etc. etc. . . .etc. . . .etc. . . .etc. . . .etc. . . .etc. . . .etc. . . .etc. . . .etc

SPECIAL OFFER I.C.s

BULK PURCHASE BRAND NEW 14 PIN DECADE COUNTER SN 7490 2 FOR ONLY **£1·00**

SPECIAL OFFER

BULK PURCHASE BRAND NEW BC 337 TRANSISTORS NPN TO 84 case 20 FOR **£1·00**

SPECIAL OFFER RESISTORS

CARBON FILM CR 25 TYPE 1m2 2m2 10% 10 120 470kΩ 5% etc . . . etc . . . etc . . .

200 MIXED FOR ONLY **£1·00**

SPECIAL OFFER DIODES

IN4148 BRAND NEW

40 FOR ONLY **£1·00**

SPECIAL OFFER 1.C 1TT

TCA270b ONLY **£3·00**

MAINS TRANSFORMER 240V INPUT 12V 8A 25V 1·1A 30V 1·5A C CORE **£2·50** P. & P. **25p.**

PAPST TAPE MOTOR 220V 50Hz **£2·50** P. & P. **25p.**

AMPLIFIER 9V 500MW **0·95p.** P. & P. **5p.**

P. A. R. BISTABLE RELAY LATCHING 24V DC4 C/O CONTACTS **0·65p.**

RELAY KEYSWITCH 24V 1 POLE 2 WAY NEW AND BOXED **0·55p.**

RELAY T.M.C. MINIATURE 3,300 ohms 2 POLE 4 WAY **0·55p.**

TELEPHONE DIALS BRAND NEW £1·00 EACH P. & P. FREE.

ELECTROLYTICS 0·1µF 250V **9p.** 25µF 50V **8p.** 40µF 16V **4p.** 16-16µF 500V CAN TYPE **35p.** 32-32µF 450V CAN TYPE **35p.**

CAPACITORS 0·047µF 400V **8p.** 125µF 10V **7p.** 100µF 10V **8p.**

FREE OFFER ONE J PACK OF YOUR OWN CHOICE WITH ALL ORDERS VALUED AT £5·00 AND OVER.

PLEASE ADD 10% TO ALL TOTAL ORDERS FOR POST AND PACKAGE.

MAIL ORDER DEPT. ONLY
(Callers by appointment)

J.E.T. ELECTRONICS

90a Mawney Road, Romford, Essex RM7 7DA
Telephone: Romford 61486

SPECIAL OFFERS ARE AVAILABLE ONLY WHILE STOCK LASTS

Make light work of wiring with the **NEW**

SELF ADHESIVE WIRE STAPLES

Countless uses in industry and offices

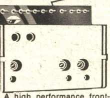
- ***QUICK AND EASY TO APPLY – EVEN IN AWKWARD PLACES**
- ***SAVES DAMAGE TO WOOD AND PAINTWORK**
- ***STICKS ON INSTANTLY : HOLDS WIRE FIRMLY**

You'll save enormous time and trouble with the new Brandauer adhesive staple. Just peel off the backing strip and press staple into place. Then bend clips over to hold wire firmly in position. No messing with pins, tacks, soldering or drilling. No damage to woodwork, e.g. skirting boards. Use the Brandauer Staple for any wall, frame or cabinet wiring jobs — it's wonderfully easy for fitting in those awkward corners.

Send now for details to:

SPECIAL PRODUCTS DISTRIBUTORS LTD.
81 Piccadilly, London W1V OHL. Tel: 01-629 9556.

NEW! V.H.F. FRONT END/CONVERTOR



- ● **ADVANCED DESIGN**
- ● **DUAL-GATE MOSFET FIRST STAGE**

COVERS: AIRCRAFT · WEATHER
SATELLITES · AMATEURS
VARICAP TUNED · INPUT 114–150 MHz
1·F OUTPUT 10·7 MHz

A high performance front-end combining high gain with low noise factor (8dB typ.). Each unit is fully tested and aligned before leaving the factory

PRICE **£9·85** (includes VAT and P. & P.)

Sole Agents: REEDHAMPTON LTD., 182-184 Addington Road, Selsdon, Surrey, CR2 8LB

GLADSTONE RADIO

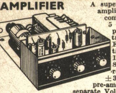
66 Elms Road, Aldershot, Hants. GU11 1LP

Callers welcome (closed Weds.). VAT inc. Add 10% post unless given in brackets

FADER for interior car courtesy light (delays 5 sec after closing door), resin embedded approx. 1½in cube, **£2·50.** CARBON slider pots, mono **45p;** stereo **55p** (12p any qty.). 100 LOTS ¼W and ½W carbon resistors, **25p** (11p); hi-stab., **50p** (17p); ceramic caps, **60p** (10p); silv. mica, **35p** (10p); w.w. resist., **£3** (20p); mixed tag strips up to 10 tags, **50p** (17p). 5 × 5yd pvc covered flex and solid wire **20p** (10p). MAINS RELAY by ITT, 3-pole c.o. with 11 pin base and holder, perspex cover, 4kΩ coil, **£1·20** (15p); Mullard LP1173 amp. module 10W, **£2·20** (15p); 20 assorted switches **£2** (45p). 5lb bargain parcel electronic surplus parts, all unused, **£1·40** (60p), 10lb ditto, **£2·50** (80p). P.E. electronic ignition kit, Scorpio 2, + or −ve. ground, **£9·50** (50p) or **£12·50** built (50p). MAINS TRANSFORMERS 240V: E—250V 50mA, 6·3V 1½A, **£1** (35p); J—37V 2A, 24–0–24V 150mA, **£4** (85p); Q—100V 100mA, 25V 250mA, 6·3V 1A, **£1** (35p); R—230V 60mA, 6·3V 2A, **£1·25** (35p); W—230V 50mA, 22V 1A, 6·3V 1A, **£1** (35p); X—300–0–300V 70mA, 6·3V 2½A, 6·3V 1A, **£1·75** (45p); Z—250V 25mA, tapped at 90V for 100mA, **85p** (35p); AA—100–0–100V 100mA, **£1·25** (35p); BB—12·6V ½A, 6·3V 5A, **£1·10** (60p); CC—270V 50mA, 6·3V c.t 2A, **£1·10** (50p); DD—250–0–250V 45mA, 6·3V 3A, **£1·25** (50p); JJ—90V 20mA 3–0–3V 200mA, **60p** (25p); KK—180–0–180V 60mA, 6·3V 2½A, **£1·75** (50p); LL—200–0–200V 60mA, 6·3V 2½A, **£1·75** (50p).

Any excess postage on multiple orders will be refunded

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 Silicon transistors plus 2 power out-put transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz. 30KHz ±3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE **£12·50.** P. & P. 65p.

DE LUXE STEREO AMPLIFIER

A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line-up:–2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built and tested to a high standard. **£10·75.** P. & P. 85p.

POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on lead.
Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3½" × 2¼". Suitable for Transistor Radios, Tape Recorders, Amplifiers etc. etc. Ready built and tested. **Price £5·20. P. & P. 55p.**

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price **£1·30** yd. length. P. & P. 30p per yd. (min. 1 yd.). S.A.E. for samples.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound fully solated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3·5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer.
P. & P. 60p. BARGAIN PRICE **£4·20**

FEW ONLY. High grade mains transformer with grain orientated lamination. Primary 200/240. Secondary 18·5 volts at 0·6 amps and 4·6 volts at 0·3 amps. Size 2in. long × 2½in. wide × 2in. deep overall. **£1·35** plus 35p P. & P.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0–210–240v. Secondary combinations 0–5–10–15–20–25–30–35–40–60v. half wave at 1 amp. or 10–0–10, 20–0–20, 30–0–30v. at 2 amps fulls wave. Size 3in. long × 3½in. wide × 3in. deep. Price **£2·60.** P. & P. 64p.

MAINS TRANSFORMER. For transistor power supplies.
Pro. 200/240v. Sec. 9–0–9 at 500 mA. **£1·25.** P. & P. 30p.
Pri. 200/240v. Sec. 12–0–12 at 1 amp. **£1·40.** P. & P. 30p.
Pri. 200/240v. Sec. 10–0–10 at 2 amp. **£2·00.** P. & P. 40p.

3 VOLT RELAY. 100 m/a single pole normally closed. 2 for **60p.** P. & P. 15p.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER

For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1¾" × 1¼" × ¾". Brand new complete with instructions. Price **£1·20.** P. & P. 15p.

HANDBOOK OF TRANSISTOR EQUIVS. AND SUBS. A must for servicemen and home constructors. Including many 1000's of British, U.S.A. European and Japanese transistors. ONLY **40p.** Post 5p.

3 Reference Encyclopedias for Electronic Engineers and Designers, covering between them transistor characteristic, diode and transistor equivalents. Many thousands of up to date European types listed.
Diode Equivalents 90p. Transistor Equivalents £1. Transistor Characteristics £1·30. POST FREE
All three together **£3.**

NEW ISSUE

Thyristor, Triac, Diac etc. encyclopedias **£1.** Post Free.

8 pole 3 way 2 bank low loss Yaxley type switches 1¼" sections. Standard spindle. 2 switches **64p** + 10p P. & P.

HARVERSONIC MAINS OPERATED SOLID STATE STEREO FM TUNER

Enjoy Fabulous Stereo Radio at this Low Introductory Price!

Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the very latest circuitry techniques with high-grain, low noise IF stages. Automatic frequency control to "lock on" station and prevent drift. IC stereo decoder for maximum stereo separation. I.E.D. for stereo beacon indicator. Nominal output of tuner 100mV. Approximate size 12½in wide × 8in deep by 2¾in high. Supplied ready built, fully tested and fully guaranteed (not available in kit form).
Price £23·00. Post and Packing £1·00.

STEREO-DECODER SIZE 2" × 3" × ½"

Ready built. Pre-aligned and tested. Sens. 20-560mV for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. **£5·40** plus 15p P. & P. Stereo beacon light if required 40p extra.

LATEST HI SENSITIVITY UNI-DIRECTIONAL SLIM-LINE CONDENSER MICROPHONE as used by many professionals. Very low acoustic feedback. Available Hi impedance or low impedance. State which required. **£13·50.** P. & P. 25p.

LATEST ACOS GP91/1SC mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **£1·46.** P. & P. 15p.
CERAMIC STEREO CARTRIDGE. Universal mounting brackets and turnover stylus. 70mV per channel output. ONLY **£1·75. P. & P. 15p.**
SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78.
ONLY £2·27. P. & P. 10p. Also available fited with twin Diamond T/O stylus for Stereo LP. **£2·76.** P. & P. 15p.
LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo 78. **£1·60.** P. & P. 15p.
LATEST T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only **£1·47.** P. & P. 15p.

QUALITY RECORD PLAYER AMPLIFIER MK. II A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in wide × 3in deep × 6in high. Ready built and tested. PRICE **£5·50.** P. & P. 75p.
ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE **£6·70.** P. & P. 75p.

HI-FI LOUDSPEAKER SYSTEM MkII

Beautifully made simulated teak finish enclosure now with most attractive slatted front. Size 16¼" high × 10¼" wide × 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" × 8" bass unit, H.F. tweeter unit and crossover. AVAILABLE IN NOMINAL 4 ohm, 8 ohm or 16 ohm impedance (state which).

OUR PRICE £9·50 each. Carr. 90p.

Cabinet Available Separately £5·00. Carr. £1·00.

Also available in 8 ohms with EMI 13" × 8" bass speaker with parasitic tweeter **£8·00.** Carr. £1·00.

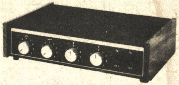
LOUDSPEAKER BARGAINS

5in. 3 ohm **£1·25,** P. & P. 15p. 7 × 4in. 3 ohm **£1·40,** P. & P. 25p. 10 × 6in. 3 or 15 ohm **£2·10,** P. & P. 35p. E.M.I. 8 × 5in. 3 ohm with high flux magnet **£1·70,** P. & P. 25p. E.M.I. 13½ × 8in. with high flux ceramic magnet with parasitic tweeter 3, 8 or 15 ohm **£3·50,** P. & P. 35p. E.M.I. 13 × 8in 3, 8 or 15 ohm with inbuilt tweeter and crossover network **£4·65,** P. & P. 35p.
E.M.I. tweeter. Approx. 3½". Available 3 or 8 or 15 ohms, **£1·80** + 25p, P. & P.
BRAND NEW. Bakers Loudspeakers at substantial discounts. 12in. 15w. H/D Speakers, 3, 8 or 15 ohms. State which. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly **£7·50.** Guitar models: 25w. **£7·50.** 35w. **£8·50.** P. & P. 75p.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11¾" × $14\frac{11}{16}$" × $1\frac{7}{16}$" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz–20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for details. Only **£6·60** each. P. & P. 60p.
NOW ALSO AVAILABLE 8in. 10W rms 20W peak 40Hz—20,000Hz. Overall depth 1in. Ideal for Hi-Fi or for use in cars. **£4·32.** P. & P. 40p.

SPECIAL BARGAIN OFFER!
Limited number of BSR C123 Auto Changer De Luxe with lightweight tubular arm and stereo cartridge.
Brand new. ONLY £8·00 + p. & p. 60p.

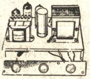
HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specifications: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12–30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12–15,000 Hz. Bass, boost approx. to ±12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.
Overall Size 12"w. × 8"d. × 2¾"h.
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

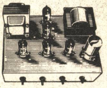
AMPLIFIER KIT	**£12·96**	P. & P. 50p
(Magnetic input components 33p extra)		
POWER PACK KIT	**£4·32**	P. & P. 55p
CABINET	**£4·32**	P. & P. 55p

(Post Free if all units purchased at same time)
Full after sales service
Also available ready built and tested **£28·08.** Post Free.
Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc.) and will then provide mixing and fading facilities for medium powered Hi-Fi Discotheque use, etc.



3-VALVE AUDIO AMPLIFIER HA34 MK II.
Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4¾"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£6·50.** P. & P. 70p.
HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. **£5·50.** P. & P. 70p.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p × SAE (Free with parts). All parts sold separately. ONLY **£10·25.** P. & P. £1·00. Also available ready built and tested **£14·00.** P. & P. £1·00.

HI-FI STEREO HEADPHONES

Adjustable headband with comfortable flexifoam earmuffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30–15,000Hz. Matching impedance 8–16 ohms. Easily converted for Mono. PRICE **£3·50.** P. & P. 25p.

PRICES INCLUDE VAT

Open 9.30–5.30 Monday to Friday. 9.30–5 Saturday
Closed Wednesday.
Prices and specifications correct at time of press. Subject to alteration without notice

HARVERSON SURPLUS CO. LTD.

(Dept. P.E.) 170 HIGH ST., MERTON, LONDON, S.W.19 Tel.: 01-540 3985
A few minutes from South Wimbledon Tube Station
SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

(Please write clearly)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

Middlesex Polytechnic

Teaching Craft and Design

(Woodwork, Metalwork, Technology, Technical Drawing)

- One-year or three-year full-time courses leading to qualified teacher status and possibly BEd degree
- Special Entry possible for mature students without academic qualifications
- Apply *now* for September 1975

There is an urgent demand for men and women teachers of Craft and Design in secondary schools, teaching woodwork, metalwork, technology and technical drawing. If you are looking for job satisfaction and a *new* career then why not consider teaching Craft and Design?

These courses are based at our Trent Park, Cockfosters site, which is situated in 300 acres of parkland only 15 miles from the centre of London.

Entry requirements:

- One-year course: Minimum age 23; HND, HNC or City and Guilds full technological certificate.
- Three-year course: Minimum age 18; five O levels (including English); mature students (over 24) can take Special Entry tests.

Please write or telephone for further details and application forms, stating whether you are interested in the one-year or three-year course, to: **The Admissions Office, Ref PE/5, Middlesex Polytechnic, Trent Park, Cockfosters, Barnet, Herts EN4 0PT, telephone: 01-449 9691.**

10B

★ ELECTRONIC PIANO KIT

★ SYNTHESISER KIT

★ ELECTRONIC ORGAN KITS

There are five superb Electronic Organ kits specially designed for the D-I-Y enthusiast. With the extreme flexibility allowed in design, you can build an organ to your requirements, which will compare with an organ commercially built costing double the price.

★ Portable organ with 4 octave keyboard, **£145·29.** ★ Console organ with 5 octave keyboard, **£250·93.** ★ Console organ with 2 × 4 octave keyboards and 13 note pedal board, **£470·65.** ★ Console organ with 2 × 5 octave keyboards and 32 note pedal board, **£680.** ★ Console organ with 3 × 5 octave keyboards and 32 note pedal board, **£960.** ★ W/W Sound Synthesiser Kit, **£149.** ★ W/W Touch Sensitive Electronic Piano, **£110.**

All components can be purchased separately, i.e., semiconductor devices, M.O.S. master oscillators, coils, keyboards, pedal boards, stop tabs, draw bars, key-contacts, etc. Lesley type speaker units from **£50.**

Send 50p for catalogue which includes 5 × 10p vouchers or send your own parts list, enclosing S.A.E. for quotation.

Elvins Electronic Musical Instruments

12 Brett Road, Hackney, London E8 1JP (Tel. 01-986 8455);
8 Putney Bridge Road, London SW18 1HU (Tel. 01-870 4949);
40a/42a Dalston Lane, Dalston Junction, London E8 (Tel 01-249 5624).

Business hours: Open 10 a.m. to 7 p.m. Monday to Saturday. Closed all day Thursday. Open 10 a.m. to 1 p.m. Sunday.

SPARKRITE MK 2

CAPACITIVE DISCHARGE
ELECTRONIC IGNITION KIT

"Sparkrite MK 2" is a high performance, high quality, capacitive discharge, electronic ignition system. Sparkrite completely eliminates problems of the contact breaker. Misfire due to contact breaker bounce is electronically eliminated, contact breaker burn is eliminated, the condition of the contacts is not relevant to the performance of the ignition, and the system is no longer dependant on the dwell period for recharging.

Sparkrite will give you: Up to 20% better fuel consumption, instant all weather starting, cleaner plugs, faster acceleration, higher top speed, longer coil and battery life, efficient fuel burning and less air polution, smoother running, continual peak performance.

The Kit comprises everything needed. Already drilled and guaranteed components and parts.

Prices: D.I.Y. assembly kit £10·93*. Ready built unit £13·86*. (Both to fit all vehicles with coil/distributor ignition up to 8 cylinders.) Switch for instant changeover from "Sparkrite" ignition to conventional ignition £2·79*. R.P.M. limiting control £2·42*. Details of more specialised units on request.

CALL IN AND SEE US FOR A DEMONSTRATION.

ELECTRONICS DESIGN ASSOCIATES of WALSALL

ALUMINIUM BOXES

Prices include lids, screws and V.A.T. (@ 8%). Add 18p to the total order value for postage and packing.

No. 7	5¼" x 2¾" x 1½"	high	47p
No. 8	4" x 4" x 1½"	high	48p
No. 9	4" x 2¾" x 1½"	high	46p
No. 10	5¼" x 4" x 1½"	high	49p
No. 11	4" x 2½" x 2"	high	46p
No. 12	3" x 2" x 1"	high	38p
No. 13	6" x 4" x 2"	high	58p
No. 14	7" x 5" x 2½"	high	75p
No. 15	8" x 6" x 3"	high	93p
No. 16	10" x 7" x 3"	high	£1·14

FLUORESCENT LIGHT KIT

You can build this reverse polarity protected 12 v, 8 w, fluorescent light. Everything needed is supplied: white enamelled ready drilled metalwork, ready drilled heatsink, printed circuit board, high quality components and transformer, end caps, cable, the fluorescent tube, nuts bolts washers, and simple assembly and operating instructions. **Prices:** Assembly kit £3·19*. Ready built £3·78*. Diffuser £59p*.

** inc. V.A.T. p. and p.*

ORDER NOW

TO **Electronics Design Associates Dept PE5,** 82 Bath Street, Walsall, WS1 3DE. Phone 33652.

FROM Name

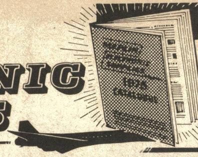
Address

QTY Please Supply
SPARKRITE MK 2 DIY Assembly kits @ £10·93
SPARKRITE MK 2 Ready Built Negative earth @ £13·86
SPARKRITE MK 2 Ready Built Positive earth @ £13·86
Ignition changeover switches @ £2·79
R.P.M. Limit systems in the above units @ £2·42
Fluorescent light assembly kits @ £3·19
Fluorescent light built units @ £3·78
Diffusers for the above @ 59p
of number alum. boxes @
of number alum. boxes @
of number alum. boxes @

I enclose cheque/P.O.s for £........

Cheque No. ....
(Send SAE if brochure only required)

MAPLIN ELECTRONIC SUPPLIES



Get your 1975 CATALOGUE!

132 Big Pages includes dozens of useful and interesting circuits you can build: data: hundreds of pictures: transistor equivalents list and hundreds of new lines. Packed with information. ONLY 40p.

NEW SHOP NOW OPEN—details below.

SUPERSONIC SAME-DAY-SERVICE-MEANS QUALITY COMPONENTS-FAST!

● RESISTORS

CARBON FILM

¼W 1Ω–1MΩ: 5%, 1MΩ–10MΩ: 10% E12.
½W 1Ω to 10Ω: 5%, 1MΩ to 10MΩ: 10% E12
11Ω to 910kΩ: 5% E12 and E24 **1p** each.

METAL OXIDE

½W 10Ω to 1MΩ: 2% E12 and E24 **4p** each.

WIREWOUND

3W 0·22Ω, 0·27Ω, 0·33Ω, 0·47Ω: 10%; 1Ω: 5% **17p** each.
1·2Ω to 270Ω: 5% E12 **13p** each.
Other ranges stocked. See our catalogue for details.
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and decades. E24: 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and decades.

● POTENTIOMETERS

Rotary miniature carbon track ¼in spindle.
Values available: 5kΩ, 10kΩ, 25kΩ, 50kΩ, 100kΩ, 250kΩ, 500kΩ, 1MΩ, 2MΩ.
Log. Single-gang **17p.** Lin. Single-gang (+ 1kΩ) **17p.**
Log. or Lin. Single-gang with switch **36p.**
Log. or Lin. Dual-gang without switch **54p.**

Slider 60mm track. Metal-cased: overall length 86·15mm (knob 7p extra).
Values available: 1k, 5k, 10k, 25k, 50k, 100k, 250k, 500k. Lin Single Gang **36p.** Log Single Gang **36p.** Lin or Log Dual Gang **45p.**

Presets: 0·1W vert. or hor. 100Ω, 220Ω, 470Ω, 1kΩ, 2.2kΩ, 4·7kΩ, 10kΩ, 22kΩ, 47kΩ, 100kΩ, 220kΩ, 470kΩ, 1MΩ **7p** each.

● CAPACITORS

Sub-miniature
Axial lead electrolytic

Mfd	V	Price	Mfd	V	Price	Mfd	V	Price
1	63	6p	47	63	6p	330	16	14p
1·5	63	6p	68	6·3	6p	330	63	28p
2·2	63	6p	68	16	6p	470	6·3	6p
3·3	63	6p	68	63	14p	470	10	14p
4·7	63	6p	100	4	6p	470	25	16p
6·8	40	6p	100	10	6p	470	40	25p
6·8	63	6p	100	25	6p	680	6·3	14p
10	25	6p	100	40	6p	680	16	16p
10	63	6p	100	63	16p	680	25	25p
15	16	6p	150	6·3	6p	680	40	28p
15	40	6p	150	16	6p	1000	4	14p
15	63	6p	150	25	6p	1000	10	16p
22	10	6p	150	40	14p	1000	16	25p
22	25	6p	150	63	16p	1000	25	28p
22	63	6p	220	4	6p	1500	6·3	16p
33	6·3	6p	220	10	6p	1500	10	25p
33	16	6p	220	16	6p	1500	16	28p
33	40	6p	220	25	14p	2200	6·3	25p
47	4	6p	220	40	16p	2200	10	28p
47	10	6p	220	63	25p	3300	6·3	28p
47	25	6p	330	4	6p	4700	4	28p
47	40	6p	330	10	6p			

● SWITCHES

Rotary adjustable stop. 1 pole, 2 to 12 way; 2 pole, 2 to 6 way; 3 pole, 2 to 4 way; 4 pole, 2 or 3 way **36p** each. Slide Sub-min. DPDT **9p.** Slide min. DPDT **13p.** Push to make non-locking SPST **14p.** Push-on, push-off locking DPST 250V 4A **36p.** Rocker white DPST 250V 10A **40p.** Rotary mains DPST 250V 2A **24p.** Toggle with on/off plate DPDT 250V 1·5A **25p.**

● TRANSISTORS AND DIODES

AC127	18p	BY126	13p
AC128	18p	BY127	13p
AC176	17p	BY164	49p
AD161/ 162MP	93p	BZY88 series	13p
BA100	9p	MPF102	36p
BA145	22p	OA91	6p
BC107	10p	OA200	7p
BC108	10p	OC71	20p
BC109	13p	SC146D	88p
BC109C	15p	T1S43	28p
BC142	23p	WOO5	30p
BC143	26p	WO4	33p
BC147	10p	1N914	4p
BC148	10p	1N4001	6p
BC149	12p	1N4002	6½p
BC168C	12p	1N4003	7p
BC169C	12p	1N4004	7½p
BC178	17p	1N4005	8p
BC182L	10p	1N4006	8½p
BC183L	12p	1N4007	9p
BC184L	12p	1N4148	4p
BC212L	14p	2N1302	20p
BC213L	15p	2N1303	20p
BC214L	18p	2N1304	30p
BCY71	22p	2N1711	24p
BD131	45p	2N2219	25p
BD132	54p	2N2646	45p
BD131/2MP	£1·20	2N2905	33p
		2N2926	
BD135	36p	Or	10p
BD139	49p	Ye	12p
BD140	69p	Gn	13p
BF258	35p	2N3053	18p
BF259	25p	2N3055	49p
BFX29	30p	2N3819	22p
BFX30	33p	2N5459	51p
BFX84	30p	7400	16p
BFX85	36p	7413	39p
BFX87	30p	7447	£1·10
BFX88	25p	7473	54p
BFY50	20p	7474	45p
BFY51	22p	7490	82p
BFY52	20p	7493	93p
		74121	39p

L.E.D. RED

2mcd ½in	15p
Panel mtg. clip	5p

(Other colours and 7-seg. displays in our catalogue)

● INTEGRATED CIRCUITS

CA3046 (14-pin DIL)	69p
LH0042CH (TO99)	£4·25
MC1310P (14-pin DIL)	£2·50
MC1496 (14-pin DIL)	78p
MFC4000B	59p
MFC6040	83p
NE555V (8-pin DIL)	65p
SG1495 (14-pin DIL)	£2·70
SG3402 (14-pin DIL)	£1·69
TBA801S	£1·00
µA741C (8-pin DIL)	36p
µA741C (14-pin DIL)	45p
µA747C (14-pin DIL)	£1·05
µA 748C (8-pin DIL)	39p
ZN414 (TO18)	£1·20

VOLTAGE REGULATORS

µA7805 5V 1·5A (TO3)	£1·75
µA7815 15V 1·5A (TO3)	£1·75
MVR 5V, 12V, 15V, 500mA (TO3)	£1·60
µA78M05 5V 500mA	£1·05
µA78M15 15V 500mA	£1·05
µA78L05 5V 100mA (TO92)	60p
µA78L15 15V 500mA (TO92)	60p
µA723C Variable 2 to 37V (TO99 or 14-pin DIL)	75p

Our catalogue contains application circuits and data for all the above I.C.s and many more.

DISCOUNTS

Details in our catalogue. Start collecting MES Discount Vouchers NOW!

BCD OUTPUT SLIDE SWITCH

Marks the end of the old-fashioned thumb-wheel switch. With 7-segment type read-out. Full details in our catalogue **£1·38.**

● PLUGS AND SOCKETS

Din	Plug	Chassis Socket
2-pin	8p	6p
3-pin	9p	7p
4-pin	10p	7p
5-pin A (180°)	10p	7p
5-pin B (240°)	10p	7p
6-pin	10p	9p

JACK PLUGS

2·5mm Plastic Barrel	9p
2·5mm Metal Barrel	15p
3·5mm Plastic Barrel	9p
3·5mm Metal Barrel	15p
¼in Std. Mono Plastic Barrel	13p
¼in Std. Mono Metal Barrel	24p
¼in. Std. Stereo Plastic Barrel	18p
¼in Std. Stereo Metal Barrel	30p

JACK CHASSIS SOCKETS

2·5mm open-type metal	9p
3·5mm open-type metal	9p
¼in Std. Mono open-type metal	10p
¼in Std. Mono moulded with 2 break contacts	14p
¼in Std. Stereo open-type metal	15p
¼in Std. Stereo moulded with 3 break contacts	21p

In-line sockets of all above types stocked.

PHONO

Plastic-topped plug	6p
Screened plug	12p
Chassis socket single	4p
Chassis socket twin	6p

● MAINS CONNECTORS

P360 3-pin 1·5A Chassis plug with line socket	33p
SA2190 3-pin 5A Chassis plug	25p
SA1862 Line socket for SA190	28p
P437 3-pin 5A Chassis socket with line plug	66p

● TRANSFORMERS

LT700 min. output. Pri. 1kΩ; Sec. 5Ω 200mW **50p;** Sub-min mains 6–0–6V 100mA **95p,** 12–0–12V 50mA **95p** (Size both approx. 30 × 27 × 25mm).
Min. mains 0–6V 500mA, 0–6V 500mA **£1·55;** 0–12V 250mA, 0–12V 250mA **£1·55;** 0–20V 150mA, 0–20V 150mA **£1·55;** 0–24V 125mA, 0–25V 125mA **£1·55.**

Mains MT3AT: Sec: 12–15–20–24–30V 2A **£3·98.**
Mains MT206AT: Sec: 0–15–20V 1A, 0–15–20V 1A **£3·98.**

● ORGANS

A Full Scale Electronic Organ That You Can Build To Your Own Specification.

FULL CONSTRUCTIONAL DETAILS IN OUR LEAFLETS.

Leaflet MES51: Price **15p,** describes a fully polyphonic basic organ which can later be used as the basis of a large sophisticated instrument.
Leaflet MES52: Price **15p** continues the description of the MES50 series organs and shows you how to add a second keyboard with lots more stops.

● THE AMAZING DMO2

A ready-built, tested and guaranteed digital master oscillator. Accurately generates the top 13 notes for your organ system and reduces the complete tuning of your organ to ONE SIMPLE adjustment. New design gives selectable C to C output ranges of (approx.) 4kΩ to 8kΩ (highest) or 2kΩ to 4kΩ or 1kΩ to 2kΩ, etc. right down to 16Hz to 32Hz! And this new compatible design is even smaller: only 3·5in × 3·7in including gold-plated edge connection.
DMO2T includes built in variable depth and rate frequency shift tremulant.
DMO2 **£12·25** DMO2T **£14·25**
SAJ110: 7-stage frequency divider in 14-pin DIL package. Sine or square wave input. Square wave output may be converted to saw-tooth. **£1·80** each or 6 for **£9·94** or 12 for **£18·16.**
Keyboards high quality, fully sprung.

Flat-front 48-note F to E	£15·95
Sloping-front 49-note C to C	£15·95
Sloping-front 61-note C to C	£20·44
Swell pedal with 10kΩ log. pot	£6·33
*Spring Line Unit (short)	£3·05
*Spring Line Unit (long)	£8·29
*Reverberation Driver Module	£5·34

*S.A.E. please for full details: leaflet MES24.

Gold-clad phosphor-bronze wire	30p per yd
Palladium earth bar	15p per octave length
Contact Blocks 2-make (GB2)	22p
Stop Tabs rocker type not engraved (white, red, grey or black) with DPDT switch	59p

SPECIAL OFFER 15 BC108Cs £1

All brand new marked I.T.T. Guaranteed full spec. highest gain group.

"ELECTRONICS TODAY INTERNATIONAL" 4600 SYNTHESISER

We stock all parts for this brilliantly designed synthesiser. This includes all the P.C.B.s, metal-work and drilled and printed front panel giving a truly professional finish. Authoritative opinions agree the E.T.I. International Synthesiser is technically superior to most of today's models. Complete constructional details in our booklet, available shortly. S.A.E. please for price list and specification. We also stock all parts for the P.E. Synthesiser, and Minisonic.

P.O. Box 3, Rayleigh, Essex. Tel. Southend-on-Sea (0702) 44101
SHOP NOW OPEN: 284 LONDON ROAD, WESTCLIFF-ON-SEA, ESSEX

VAT Please add 8% to the final total. Post and Packing FREE in U.K. (15p handling charge on orders under £1)
First-class post pre-paid envelope supplied free with every order.

TRAMPUS Electronics Ltd.

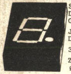
Buy it with Access
BARCLAYCARD

WINDSOR, BERKS.
58/60 GROVE RD:

MONEY BACK IF NOT SATISFIED.
LARGE STOCKS. LOW PRICES.
ALL BRAND NEW TOP GRADE FULL
SPEC DEVICES.CALLERS WELCOME.
CATALOGUE/LIST FREE SEND SAE.
BARCLAYCARD & ACCESS x POST.

SEND C.W.O. ADD VAT TO ALL PRICES IN U.K.P&P 15p. EXPORTS 60p.

Digital Displays



SLA7 RED LED 0.3"
DIGIT 0-9DP 89p ea
GREEN&YELLOW £1.40

JUMBO LED 0.6" 747
DISPLAY £2.25 ea.

3015F 0-9DP £1 ea.

ZENON FLASH TUBE
£4. .Data 15p.

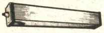
LEDS red 13p

LEDS 209 STYLE	ONLY	13p ea
TIL 209 WITH CLIP	RED	15p ea
TIL 211 & CLIP	GREEN	29p ea
LARGE 0.2" & CLIP	RED	17p ea
LARGE 0.2" CLIP	GREEN	30p ea
209 STYLE OR .2"	ORANGE	29p ea

INFRA RED LED £1.2N5777 33p.

PHOTO IC 81p

TEC12 PHOTO AMP/SCMITT/RELAY
DRIVER or LED TTL INTERFACE 81p



FLUORESCENT LIGHTS 12V MADE IN UK
8 WATT 13" £3. 13W 22" £3.50

DIGITAL CLOCK

IC AY51224 4 DIGIT CLOCK £3.75
MM5311/4 6 DIGIT CLOCK £7

CASSETTE mechanics £13·75

NEW 8tk CARTRIDGE MECHANISM £8

STEREO CASSETTE MECHANISM £13.75
Suitable for 'PW ASCOT' recorder
with heads etc.SEND 15p for DATA

INTEGRATED CIRCUITS

709 DIL14	29p
555 TIMER	54p
703 RF/IF	28p
709 T099	23p
709 DIL 14	28p
710 DIL 14	34p
723 Reg.	54p
741 DIL 8	27p
741 DIL 14	29p
741 TO99	29p
747 2x741	70p
748 DIL 8	33p
7805 5V	£1.40
7812 & 15	£1.40
76013 6W AF	£1
8038 SIG GEN	£3
CA3028	£1
CA3046	55p
CA3048	£2
CA3052	£1.50
CA3054	£1
LM300 2-20V	£2
LM301 OPA	45p
LM304 0-40V	£3
LM307 OPA	49p
LM308 HiBo	95p
LM309K 5V	£1.48
LM372 IF	£1.80
LM377 2x2W	£2.87
LM380 2W AF	89p
LM381 2xPre	£2
LM3900 4xOPA	69p
MC1303	£1.20
MC1306	49p
MC1310&LED	£2.65
MC1312 SQ	£2.10
MC1330	69p
MC1339 2xPre	£1
MC1350	55p
NE536 fetOPA	£2
NE540 Driver	£1
NE550 2vRef	79p
NE555 Timer	55p
NE556 2x"	£1.20
NE560 PLL	£3.15
NE561 PLL	£3.15
NE562 PLL	£3.19
NE565 PLL	£2,69
SN72709 709	28p
SN72741 741	26p
SN72748 748	33p
SN76660 IF	£1
SN76611 IF	£1,25
TAD110 &IF	£2
TBA810 7WAF	99p
ZN414 RX	£1.09

SPECIAL OFFERS

2N3055 FULL HIGH SPEC 115W 37p
741C 8PIN DIL 27p.MFC4000B 33p
NE555 TIMER 55p.ZN414 RX £1,09
BC109 9p.2N3819e 16p.BFY51 15p

74N TTL

7400 GATES	13p
7404 INVERT	17p
7401/2/10etc	14p
7413 SCMITT	31p
7440 BUFFER	14p
7447 DRIVER	89p
7470 & 7472	29p
7473/74/76	29p
7475	45p
7490	52p
7491/2/3/4	59p
74100 74175	£1
74121	32p
74123	59p
74141(&7441)	73p

TRANSISTORS & DIODES

Price each	
AC127 & 128	16p
AC187 & 188	19p
AD149	43p
AD161 & 162	33p
BC107 & 108	9p
BC109	10p
BC147/8/9	10p
BC157/8/9	12p
BC167/8/9	12p
BC177/8/9	18p
BC182/3/4A&L	10p
BC212/3/4A&L	11p
BCY70/1/2	17p
BD131 & 132	39p
BFR51	
BFR50/51	23p
BFR50/51	23p
BFR88 250V	29p
BFY50/1/2	15p
BSX19/20/21	16p
MJE2955	90p
MJE3055	65p
MPU131 PUT	49p
OA91 OA81	6p
OA81 & OA91	6p
TIP 29 & 30	52p
TIP 31 & 32	69p
MATCHING	16p
INS.BUSH SET	10p
TIP 41	70p
TIP 42	88p
TIP 2955	90p
TIP 3055	55p
TIS43 *see2N2646*	
ZTX109&301	13p
1N4001	4p
1N4004 & 7	7p
1N4148 & 914	4p
2N697	14p
2N706&8	11p
2N2646 UJT	32p
2N2904 & 5	20p
2N2926roYg	9p
2N3053	17p
2N3055 115W	37p
2N3563 & 64	16p
2N3614	49p
2N3702 & 3	9p
2N3704 & 5	10p
2N3706 & 7	9p
2N3708 & 9	8p
2N3710 & 11	10p
2N3819E FET	16p
2N3823E FET	17p
2N3904/5/6	15p

FULL SELECTION IN OUR FREE LISTS,

NEW TRAMPUS FULL SPEC PAKS

PAK A 10 RED LEDS our choice £1
PAK B 4 741 OP AMP " " £1
PAK C 4 2N3055 £1.D 12 BC109 £1
PAK E 10 BC182 £1.F 11 2N3704 £1
PAK G 8 BFY51 £1.H 9 2N3819e£1
PAK J 9 2N3053 £1,K 40 1N914 £1

BZY88 400mW
ZENER DIODES 9p

BRIDGE RECT
1A 50V 20p

BR100 DIAC 25p

1A/50V SCR 36p
TAG1/400 55p
C106 & 7 SCR D1
4A/400V 53p
SC146D TRIAC
10A 400V 75p

vero NEW LOW PRICES!

VERO PINSx36 28p.
COPPER CLAD VEROBOARD 0.1"

2½"x5" 29p 2½x3¾" 26p.3¾x3¾"31p.
3¾"x5" 31p 3¾x 17" £1.50

DIL IC's BOARDS 6x4½" £1.50
24 way edge connector 60p.
36 way 90p. PLAIN 3¾"x17" £1.
FACE CUTTER 45p.FEC ETCH PAK 50p

DALO pen69p

PRINTED CIRCUIT BOARD KIT £1.69
DECON NO MESS ETCH PAK NEW 69p
DECON DESOLDER BRAID REEL 59p

HEATSINKS

5F/T05 & 18F/T018 5p ea.TV4 15p.
TV3/T03 16p.EXTRUDED 4" 4Y1 29p.

TGS308 GAS DETECTOR £1.80 ea.
LOGIC PROBE TTL TESTER PEN £5

CAPACITORS

CERAMIC 22pf to 0,1uf 50v 5p,
ELECTROLYTIC:10/50/100 uf in
10v 5p,25v 6p.50v 8p.2uf/10v 5p.
1000 uf/25v 18p.200/500 25v 9p.

POTENTIOMETERS (POTS) AB or EGIN

LIN or LOG ROTARY 13p.SWITCH 14p
DUAL 45p.SLIDERS 29p.STEREO 57p
KNOBS 7p.PRESETS 6pRESISTORS 1½p

SWITCHES: SPST 18p. DPDT 25p.

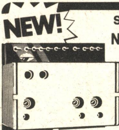
DIN PLUGS ALL 12P. SOCKETS 10P.
ALI CASES AB5/AB7 50p.AB13 65p.
TRANSFORMERS 1A 6v6v or 12v12v
Only £1,34.100mA type CT 75p.

DIL sockets

TEXAS GOLD
LOW PROFILE ea
8,14,& 16 PIN 13p

SOLDERCON STRIPS:
100 PINS 50p.1K £3.

Burneze – unique aerosol first aid cools instantly, contains a fast-acting local anaesthetic *plus* antihistamine to control swelling. It deals with the lingering pain of a minor burn or scald and reduces the chance of a blister.
From Boots and other chemists. S.A.E. to Potter & Clarke, Croydon CR9 3LP, for intriguing leaflet.



SOUP UP YOUR TUNER!

New De-Luxe I.F. strip

- SHARP SKIRT SELECTIVITY
- CONTROLLABLE SQUELCH
- CENTRE ZERO TUNING METER + SIGNAL STRENGTH METER OUTPUT

This I.F. Amp. has a low noise pre-amplifier stage. Matching two 10·7MHz filters into an I.C./I.F. amp. Full application notes available, send S.A.E. + 8p.

SEND **£6·99** + 56p VAT + 20p P. & P. Total **£7·75**

Sole U.K. Agents: **REEDHAMPTON LTD**
182–184 Addington Road, Selsdon, Surrey CR2 8LB

FABULOUS—FANTASTIC

P.E. ORION

FULL KIT OF PARTS, **£38.**
Transformer and Screen Printed Board, **£11.**
Complete Semiconductor Kit, **£9·50.**
H.M. Bookend Case, **£4.**
As above but drilled, punched with Silk Screened Front Panel, £5·80.

ASTRO IGNITION SYSTEM

Complete Kit of Parts for this well proven Transistorised Ignition System, **£9·50**
Ready-built with only 2 connections to alter, **£12·50**
Thousands of these units are in use today and have been proven to give the following advantages: fuel economy, faster acceleration, exellent cold start, smoother running, no contact-breaker burning and many more.

Money back guarantee if you are not satisfied. Please state whether positive or negative earth.

Postage included in above prices but add V.A.T. at 8%.

ASTRO ELECTRONICS
Spring Bank Road, West Park, Chesterfield, Derbyshire

INSULATED TERMINALS

Available in Black, Red, White, Yellow, Blue, and Green. Brand New **13p** each Post Paid.

METERS NEW! 2½in. Flush round. Available in D.C. Amps 1, 5, 10, 15, 20 or A.C. Amps 1, 5, 10, 15, 20, Voltmeter 0–300V A.C. All types **£2·50.** Post 20p.

600 WATT DIMMER SWITCH Easily fitted. Fully guaranteed by makers. Will control up to 600W of lighting except fluorescent at mains voltage. Complete with simple instructions. **£2·75.** Post 25p.

RELAYS SIEMENS, PLESSEY. Etc, MINIATURE RELAYS

Col. (1) Coil ohms	1	2	3	4
	52	4–8	2 c/o	**70p***
Col. (2)	58	5–9	6 c/o	**80p**
Working	185	8–12	6M	**60p***
d.c. volts	230	9–18	2 c/o	**70p***
Col. 3	430	15–24	4 c/o	**80p***
Contacts	700	12–24	2 c/o	**60p***
Col. (4)	700	16–24	4M 2B	**60p***
Price	700	16–24	4 c/o	**80p***
	1,250	18–36	2 c/o	**60p***
HD =	2,500	31–43	2 c/o HD	**60p***
Heavy duty	2,500	36–45	6M	**60p**
	9,000	40–70	2 c/o	**60p***
	15k	85–110	6M	**60p***

*Incl. Base. All prices incl. P. & P.

OPEN TYPE RELAYS

6 VOLT D.C. 1 make contacts **35p.** Post 15p.

9 VOLT D.C. RELAY
3 c/o 5 amp contacts. 70 ohm coil. **75p.** Post 15p.

12 VOLT D.C. RELAY
3 c/o 5 amp contacts. 120 ohm coil. **75p.** Post 15p.

24 VOLT D.C. 3 c/o **75p.** Post 15p.
2 HD c/o 700 ohm coil. **75p.** Post 15p.
4 c/o 300 ohm coil. **85p.** Post 15p.

ENCLOSED TYPE RELAYS

24 VOLT A.C. Mfg. by ITT.3 h.d. c/o contacts. **55p.** Post 10p. Base **15p.**

55 VOLT A.C. RELAY
3 h.d. c/o contacts. Price **55p.** Post 10p. Base **15p.**

100 VOLT A.C. 2 c/o sealed type. **75p.** Post 10p. Base **15p.**

240 VOLT RELAY
3 h.d. c/o contacts. Price **75p.** Post 15p. Octal plug in base 15p extra.

230/240 VOLT A.C. RELAY. Mfg. by Arrow 2 h.d. 15 amp c/o contacts. Amp connectors. Price **£1.** Post 15p.

220/240 VOLT A.C. RELAY
3 c/o 5 amp contacts. Sealed. Mfg. ISKRA. **£1·25.** Post 15p. Base 15p extra.

CLARE-ELLIOTT TYPE RP7641 G8
Miniature relay. 675 ohm coil. 24 Volt D.C. 2 c/o. **70p** post paid.
110V. 2 c/o. 20 amp contacts. **£1·25.** Post 10p.

Many others from stock—phone for details.

VERY SPECIAL OFFER

MICRO SWITCH. 5 amp. c/o contacts. NEW. 20 for **£2.** Post 15p. (Min. order 20). Ditto press to break, 20 for **£1·50.** Post 15p.

SUB-MINIATURE REED RELAY 3-9 volt d.c.

1 make, size 1¼ × ⅜ × ⅜in.
Outstanding Value only £1 for six, **£1·50** for ten. Post 15p. (Min. order six.)

TRIAC

Raytheon Tag symmetrical Triac. Type TAG. 250/500V, 10 amp, 500 p.i.v. Glass passivated plastic triac. Swiss precision product for long term reliability **£1·00.** Post 10p. (Inclusive of Data and application sheet.) Suitable Diac **18p.**

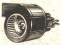
230/250 VOLT A.C. SOLENOID

Approximately 1½lb pull. Size of feet 1⅝″ × 1$\frac{3}{16}$″. Price **£1·00.** Post 15p.

24 VOLT DC SOLENOIDS

UNIT containing 1 heavy duty solenoid approx. 25lb pull 1 inch travel. Two × approx. 1lb pull ½ inch travel. 6 × approx. 4oz. pull ½ inch travel. One 24 volt d.c., 1 heavy duty single make relay. Price **£2·50.** Post 75p. **ABSOLUTE BARGAIN.**

CENTRIFUGAL BLOWER



Mfg. Airflow Developments Ltd. Precision continuously rated, smooth running, 230/240V a.c. motor 80 c.f.m. As illustration but with round aperture. **£6·50.** Post 50p.

All Mail Orders—Callers—Ample Parking
Dept. PE5, 57 BRIDGMAN ROAD
CHISWICK, LONDON W4 5BB
Phone 01-995 1560
Showroom open Mon.-Fri.

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230/240V a.c. 50/60 OUTPUT VARIABLE 0–260V All Types.

SHROUDED TYPE

200 watt (1 amp)	**£10·00**
0·5 KVA (2½ amp) (MAX)	**£11·50**
1 KVA (5 amp) (MAX)	**£16·50**
2 KVA (10 amp) (MAX)	**£30·00**
3 KVA (15 amp) (MAX)	**£33·00**
4 KVA (20 amp) (MAX)	**£72·50**
37·5 amp (MAX)	**£102·50**

CARRIAGE AND PACKING EXTRA
OPEN TYPE 1 amp (panel mount) **£10·00**

L.T. TRANSFORMERS

0, 6, 12 Volt at 10 amp.	**£5·60.**	Post 70p.
0, 10, 17, 18 Volt at 10 amp.	**£7·90.**	Post 70p.
0, 4, 6, 24, 32 Volt at 12 amp.	**£9·90.**	Post 70p.
0, 6, 12 Volt at 20 amp.	**£9.**	Post 70p.
0, 12, 24 Volt at 10 amp.	**£9·20.**	Post 70p.
0, 6, 12, 17, 18, 20 Volt at 20 amp.	**£10·40.**	Post 70p.

Other types to order at short notice—Phone your enquiries.

AUTO TRANSFORMERS

Step up step down

0–115/200/220/240 Volts. 75 watt **£2·64.** Post 40p. 150 watt **£3·50.** Post 50p. 300 watt **£6·20.** Post 60p. 500 watt **£9·20.** Post 75p. 1000 watt **£12·00.** Post 90p.

300 VA ISOLATING TRANSFORMER

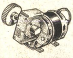
115/230–230/230 volts. Screened. Primary two separate 0–115V for 115 or 230 volt. Secondary two 115V at 150 VA each for 115 or 230 volt output. Can be used in series or parallel connections. Fully tropicalised. Length 13·5 cm. Width 11 cm. Height 13·5 cm. Weight 15 lb.
SPECIAL OFFER PRICE £5. Carr. 80p.

230/240 VOLT A.C. MINIATURE MOTOR. 20 R.P.M. Price **£1.** Post 15p.

BODINE TYPE N.C.I. GEARED MOTOR

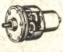
(Type J) 71 r.p.m. torque 10 lb. in. **Reversible** 1/70th h.p. cycle 0·38 amp. **(Type 2) 28 r.p.m.** torque 20 lb. in **Reversible** 1/80th h.p. 50 cycle 0·28 amp. The above two precision made U.S.A. motors are offered in 'as new' condition. Input voltage of motor 115V A.C. Supplied complete with transformer for **230/240V A.C. input.**
Price, either type **£6·25.** Post 65p or less transformer **£3·75.** Post 50p.

'FRACMO' 240 VOLT A.C. 50 cycle SINGLE PHASE GEARED MOTOR



33 r.p.m. 30 lb. ins. Reversible. Fitted with mounting feet. Brand New. **£14.** Post £1·00. (Total price incl. VAT **£15·77).**

9-12 VOLT D.C. GOVERNED REVERSIBLE MOTOR



Machine cut gear train, giving final speed of 2 r.p.m. with cam driving 3 sub-miniature micro-switches (removable). Spindle 12mm long 6mm dia. Built to PO spec., in heavy metal hinged case. **£3·75.** Post 40p.

POWER RHEOSTATS ! ! !

Superior Quality Precision Made
NEW POWER RHEOSTATS

New ceramic construction, vitreous enamel embedded winding, heavy duty brush assembly, continuously rated.

25 WATT 10/25/50/100/150/250/500/1k/1·5k/2·5k ohm. **£1·70.** Post 15p.

50 WATT 1/5/10/25/50/100/250/500/1k ohm **£2·10.** Post 20p.

100 WATT 1/5/10/25/50/100/250/500/1k/1·5k/2·5k/3·5k/5k ohm **£3·30.** Post 25p.

Black Silver, Skirted knob calibrated in Nos. 1–9 1½in. dia. brass bush. Ideal for above **22p** each.

INSULATION TESTERS *NEW!*

Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L.8in, W.4in, H.6in, weight 6lb. **500V,** 500 megohms, **£30.** Post 80p.

All prices are subject to
8% VAT. (8p in the £)
To all orders add 8% VAT to total value of goods including carriage/packaging.

SERVICE TRADING CO.

STROBE ! STROBE ! STROBE !

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation. **RANGE OF FOUR STROBE KITS FROM STOCK. PRICES FROM £6·30 to £22.** S.A.E. for details.

COLOUR WHEEL PROJECTOR

Complete with oil-filled colour wheel. 100 watt lamp. 200/240V AC. Features extremely efficient optical system. **£20·50.** Post 80p.
Extra colour effect wheels from stock. S.A.E. for details.

BIG BLACK LIGHT

400 Watt. Mercury vapour ultra violet lamp. Powerful source of u.v. P.F. ballast is essential. Price of matched ballast and bulb **£18.** Post £1. Spare bulb **£8.** Post 40p.

BLACK LIGHT FLUORESCENT U.V. TUBES

2ft 20 watt, £4·25. Post 40p. (For use in standard bi-pin. MINI. **12in 8 watt, £1·60.** Post 25p. **9in 6 watt, £1·30.** Post 25p. Complete ballast unit and holders for 9in and 12in tube, **£1·70.** Post 25p. (9in and 12in measures approx.)

U.D.I. SINGLE CHANNEL 750 WATT MANUAL/AUTO DIMMER

750W Solid State Fader, with three functions. Manual fade; Auto fade-up; Auto fade-down. Automatic cycling up and down. Functions selected with 'three-position' rocker switch. Two ranges of cycling for 'Flashing' or 'Slow blending'. Ready built module 6″ × 3″ glass fibre board incorporating 10 amp TRIAC. Two or more modules for top quality colour blending and flashing effects. PRICE **£15.** Post 45p.

50 in 1 ELECTRONIC PROJECTOR KIT

50 easy to build projects. No soldering, no special tools required. The kit includes Speaker, Meter, Relay, Transformer, plus a host of other components and a 56-page instruction leaflet. Some examples of the 50 possible Projects are: Sound Level Meter, 2 Transistor Radio, Amplifier, etc. Price **£7·75.** P. & P. 50p.

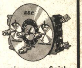
PROGRAMME TIMERS

230/240V a.c. 15 r.p.m. Motors. Each cam operates a c/o micro switch. Ideal for lighting effects, animated displays, etc. Ex equipment tested.

2 cam model.	**£2·00**	post 35p.
4 cam model.	**£2·50**	post 35p.
8 cam model.	**£4·75**	post 40p.

8 cam model, each cam fully adjustable. 6 r.p.m. M.f.g. by Magnetic Devices. **£7·50.** Post 35p.

A.C. MAINS TIMER UNIT



Based on an electric clock, with 25 amp. single pole switch, which can be preset for any period up to 12 hrs. ahead to switch on for any length of time, from 10 mins. to 6 hrs. then switch off. An additional 60 min. audible timer is also incorporated. Ideal for Tape Recorders, Lights, Electric Blankets, etc. Attractive satin copper finish. Size 135mm × 130mm × 60mm. Price **£2.** Post 40p. (Total incl. VAT and Post **£2·38**).

REVERSIBLE MOTOR

A.E.I. $\frac{1}{10}$ h.p. reversible motor 100/120 volt A.C. 50/60 cycle 1400/1680 r.p.m. Flange fixing. Dia. 4″, length 6½″, shaft 1″ × $\frac{1}{16}$″. Brand New. Price **£2·50.** Post 50p. Suitable 110/240v. 150 watt Auto Transformer **£3·50.** Post 50p. (Post for both items together 75p.)

COIN MECHANISM (Ex London Transport)
Unit containing, selector mechanism for 1p, 2p and 5p coins. Micro switches, relays, solenoid operated hopper. 24 volt D.C. Precision built to high standard. Incredible VALUE at only **£2·50.** Post 70p.

'STC' 6″ RED ALARM BELL

24/48 volt DC. **Brand New.**
Price **£4.** Post 50p.

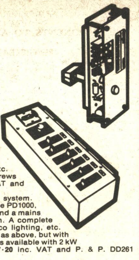
'GENTS' 6″ ALARM BELL

200/250V AC/DC. **Brand New.** Price **£5.** Post 60p.

Personal callers only. Open Sat.
9 LITTLE NEWPORT STREET
LONDON WC2H 7JJ
Phone 01-437 0576

Dimmit

range of light dimmers and lighting control systems



Illustrated is the popular PMSD1000 module. A 1kW slider control dimmer, interference suppressed, 60mm slider range size 12 × 5 × 4cm. Ideal for low cost stage and disco lighting. Used by schools, theatres, studios, etc. Complete with scale plate, fixing screws and full instructions. **£7·25** inc. VAT and P. & P.

Illustrated is the DD61 dimmer system. Contains: six 1 kW slider dimmers type PD1000, six outlet sockets, a master control and a mains on/off switch. Size 59 × 22 × 12cm. A complete system in one unit for stage or disco lighting, etc. Also available DD261 dimmer system, as above, but with 2–preset arrangement. Future systems available with 2 kW dimmers. Specials made. DD61 **£97·20** inc. VAT and P. & P. DD261 **£117·72** inc. VAT and P. & P.

The Dimmit range includes standard wall mounting models for home and office, etc. Professional modules for industrial heating applications, etc. Rotary and slider control versions. Ratings: 1000W; 2000W; 3000W; 110V and 240V.

Model SL800 sound to light converter. Modulates the light in time with sound. Built-in microphone. No connections to speaker required. Simple wiring—similar to dimmer. Rating 800W.

All products are guaranteed and are supplied with full instructions and applications. Full after-sales service. Technical advice given.

For full information on all modules and lighting control systems send 15p for our illustrated catalogue and price list. Callers welcome, visit our showroom for a demonstration of any of the modules or systems. Mon–Fri. 9.30 to 6.0 p.m. Sat. by arrangement.

YOUNG ELECTRONICS LTD.

184 Royal College Street, London NW1 9NN. **Tel. 01-267 0201**

Whether your project is electrical or electronic, SCS Components have a complete professional service for the non-professional. We are franchised distributors of Mullard components and Motorola, Ferranti, Signetics, G.I. and Monsanto, too. Our Trade Counter can supply you with all you need, including first-class technical advice. Or simply send cash with your order.

Never before have you been able to get top quality, guaranteed components so quickly, so inexpensively. Send for a free copy of our latest price list.

Try us; we think you'll notice the difference.

SCS Components,
Northfield Industrial Estate, Beresford Avenue,
Wembley, Middlesex HA0 1SD Tel: 01-903 3168

New calculator ICs/lower prices from Thurlby

General description

Increasing demand for the XE series high performance calculator chips has resulted in increases in scale allowing us to offer even better value for money.

Thurlby Electronics offer you the opportunity to build yourself an advanced electronic calculator at amazingly low cost using one of the XE series MOS single chip calculator I.C's.

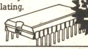
Every IC is brand new, tested and guaranteed. It comes complete with full data, circuit diagrams and wiring details covering the use of different types of displays, describing how to construct both very simple and more elaborate keyboards, and explaining the operation of the calculator – both in normal calculations and in more complex operations.

Full money back guarantee.
Cash with order.
Postage and packing 20p per order.
Please add 8%VAT to total order value.

XE303 Calculator IC

New XE303 series with memory and %

- 5 functions, + – × ÷ with automatic constant facility on all 4 plus live % key.
- Full performance memory, store-recall-exchange, or automatic accumulating.
- Full 8 digits with floating decimal point and algebraic logic
- Built-in clock generator, single power supply.
- Direct segment drive, suppression of non-significant zeros.

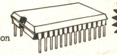


£3·25 +VAT

XE202 Calculator IC

XE202 series 4 function and constant

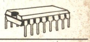
- Full 8 digits with floating decimal point and algebraic logic
- Powerful keyed constant facility on all 4 functions
- Enormous exponent range: 10^{-20} to 10^{+79}
- Single strobe line facilitates very simple keyboard construction
- Direct segment drive, suppression of non-significant zeros



£2·25 +VAT

Display driving interface chips

TK9	9 digit driver IC suitable for use with XE303 series.	95p + VAT
7105	8 digit driver IC suitable for use with XE202 series.	75p + VAT



Special magnified LED displays

9 digit suitable for use with XE303 series.	**£3·75** + VAT
8 digit suitable for use with XE202 series.	**£3·25** + VAT

To Thurlby Electronics
Church Farm House
Church End, Over
Cambs. CB4 5NH

Please supply

for which I enclose cash/cheque/PO for £ including VAT & postage

Name

Address

PHONOSONICS

SUPPLIERS OF QUALITY PRINTED CIRCUIT BOARDS, KITS AND COMPONENTS TO A WORLD-WIDE MARKET

SOUND-TO-LIGHT (P.E. Apr./Aug. 71)

The ever-popular AURORA—4 or 8 channels each responding to a different sound frequency and controlling its own light. Can be used with most audio systems and lamp intensities. A *must* for any Disco, and a fascinating visual display for the home.

4 channel component set (excl. thyristors)	£11·49
8 channel component set (excl. thyristors)	£20·32
Power supply component set	£4·78
PCB for 4 frequency channels	£2·50
PCB for power supply and 8 lamp drivers	£1·25

P.E. SYNTHESISER
Details in List

VOICE OPERATED FADER (P.E. Dec. 73)

For automatically reducing music volume during "talk-over"—particularly useful for Disco work, or for home-movie shows.

Component set, incl. PCB	£2·95

P.E. GEMINI 30W STEREO AMPLIFIER

An exceptionally high quality Stereo Amplifier system, specifications for which are shown in detail in our list, together with semiconductor requirements. While stocks last.

Main Amplifier:	
Set of resistors, capacitors and presets	£5·96
Stereo printed circuit board	£1·28
Pre-Amplifier:	
Sets of resistors, capacitors, potentiometers and switches—	
Standard Tolerance Set	£10·57
Superior Tolerance Set	£16·04
Stereo PCB (as Published)	£2·20
Regulated Power Supply:	
Set of resistors, capacitors and preset	£4·58
Printed circuit board	72p

HI-FI TAPE LINK (P.E. Mar./Apr. 73)

Designed for use with reasonable quality tape decks, this high performance pre-amp includes record, playback and metering circuits.

Stereo component set (excl. panel meter)	£22·05
Mono component set (excl. panel meter)	£13·31
Power supply component set	£3·72
Stereo main PCB	£2·50
Stereo sub-assembly PCB	86p

TAPE-NOISE LIMITER

Very effective circuit for reducing the hiss found in most tape recordings.

Component set (incl. PCB)	£2·30
Regulated power supply (including PCB)	£3·71

PROJECT Q4 (P.W. Oct. 73/Jan. 74)

Multi-system Quadraphonic Decoder.

While stocks last

Decoder component set	£13·74
Power supply components	£3·22
Printed circuit board	£2·60

SEMICONDUCTOR TESTER (P.E. Oct. 73)

Essential test equipment for the enterprising home constructor.

Set of resistors, capacitors, semiconductors, potentiometers, makaswitches and PCB	£6·56

PHASING UNIT (P.E. Sept. 73)

A simple but effective manually controlled unit for introducing the "phasing" sound into live or recorded music.

Component set (incl. PCB)	£2·20

PHASING CONTROL UNIT (P.E. Oct. 74)

(for use with above Phasing Unit)

Component set (including PCB)	£3·50

P.E. SOUND SYNTHESISER

The well-acclaimed and highly versatile Synthesiser published in P.E. Feb. 1973 to Feb. 1974.

Component sets and printed circuit boards. List shows full details including discounts.

VOLTAGE CONTROLLED FILTER (P.E. Oct. 74)

Component set	£3·41
Printed circuit board	£1·10

RHYTHM GENERATOR (P.E. Mar./Apr. 74)

Programmable for 64,000 rhythm patterns from 8 effects circuits (high and low bongos, bass and snare drums, long and short brushes, blocks and cymbal), and with variable time signatures. See list for discount.

P.E. JOANNA
Send S.A.E. for our details

ULTRASONIC TRANSMITTER-RECEIVER

A highly sensitive and long range "invisible beam" detection circuit with numerous applications.

Component set with PCBs, but excluding transducers	£4·40

P.E. RONDO
PCB details in List

POWER SLAVES
PCB details in List.

P.E. ELECTRONIC PIANO
Details in List.

HOME INTERCOM
Details in List.

(While Stocks Last)

SOUND BENDER (P.E. May 74)

A multi-purpose sound controller, the functions of which include envelope shaper, tremolo, voice operated fader, automatic fader and frequency doubler.

Component set	£5·86
Printed circuit board	£1·44

REVERBERATION UNIT (P.W. Nov./Dec. 72)

A high-quality unit having microphone and line input pre-amps, and providing full control over reverberation level.

Component set (excl. spring unit)	£6·82
Printed circuit board	£1·40

P.E. MINISONIC
Details in list
(inc. discounts)

8W AMPLIFIER (P.W. Nov. 72)

A moderately powered amplifier of more than average performance. (While stocks last.)

Main Amplifier	
Mono component set	£4·18
Stereo component set	£8·36
Pre-Amplifier	
Mono component set	£2·50
Stereo component set	£6·46

BIOLOGICAL AMPLIFIER (P.E. Jan./Feb. 73)

Multi-function circuits that, with the use of other external equipment, can serve as lie detector, alphaphone, cardiophone, etc.

Pre-Amplifier Module	
Component set and PCB	£3·48
Basic Output Circuits	
Combined component set with PCBs, for alphaphone, cardiophone, frequency meter and visual feed-back lamp driver circuits	£4·96
Audio Amplifier Module	
Type PC7	£5·50

PHOTOPRINT PROCESS CONTROL (P.E. Jan./Feb. 72)

For colour and B. & W. an indispensable dark-room unit for finding exposure, controlling enlarger timing, and stabilising mains voltage.

Component set (excl. meter)	£8·85
Printed circuit board	£1·60

ENLARGER EXPOSURE METER AND THERMOMETER (P.E. Sept. 73)

Dual-purpose dark-room unit with good accuracy.

Component set with PCB, but excluding meter	£4·00

WIND AND RAIN UNIT (P.E. Oct. 73)

A manually controlled unit for producing the above-named sounds.

Component set incl. PCB	£2·40

PCB LAYOUT AND CIRCUIT DIAGRAMS SUPPLIED WITH ALL PCBs DESIGNED BY PHONOSONICS

LIST
Send S.A.E. for free list giving fuller details of kits, PCBs, and other components.

P. & P.
Add 22p to all orders

VAT
Add 8% (or current rate if different) to total order cost including P. & P.

OVERSEAS
P. & P. will be charged extra. VAT does not currently apply. List gives fuller details including kit weights. Charge for list: Europe 10p, other countries 20p.

COLOUR CODE IDENTIFICATION SUPPLIED WITH MOST KITS AND AS PART OF LIST

Semiconductors

AC128	20p
AC176	20p
BC107	13p
BC108	13p
BC109	13p
BC147	12p
BC148	12p
BC149	12p
BC157	13p
BC158	13p
BC159	13p
BC182L	12p
BC184	12p
BC204	14p
BC209C	14p
BC212L	15p
BC213	15p
BC478	29p
BCY71	22p
BF178	40p
BFY50	22p
BFY51	22p
BFY52	24p
BSY95A	22p
MJE2955	110p
MJE3055	75p
NKT0033	112p
OC28	60p
OC71	14p
OC72	14p
OC84	25p
ORP12	60p
ZTX107	12p
ZTX503	15p
ZTX531	23p
2N706	13p
2N914	22p
2N1304	22p
2N2219	27p
2N2905	27p
2N2907	22p
2N3054	66p
2N3702	12p
2N3703	12p
2N3704	12p
2N3819	35p
2N3823E	39p
2N4060	12p
2N4871	36p
2N5245	51p
2N5777	45p

Diodes

1N914	4p
1N4001	6p
1N4002	7p
1N4004	8p
1N4005	8p
1N4007	10p
OA91	7p
OA200	8p
OA202	8p
1GP7	12p
1SJ50	11p
ZIJ (ZIL)	70p

Integrated Circuits

709 8-pin DIL	40p
709 TO5	40p
723 TO5	95p
741 8-pin DIL	40p
747 14-pin DIL	115p
748 TO5	63p
748 8-pin DIL	63p
748 14-pin DIL	63p
7400	20p
7402	20p
7410	20p
7420	20p
7447	175p
7473	44p
7489	425p
µ7815 TO220	250p
CA3046	69p
MFC6040	95p
SG3402N	169p

Zeners

3·3V 400mW	12p
3·9V 400mW	15p
4·7V 1W	25p
5·1V 400mW	15p
5·6V 400mW	15p
5·6V 1·3W	20p
6·2V 400mW	15p
9·1V 400mW	15p
11V 1W	25p
12V 400mW	15p
12V 1·3W	20p
18V 400mW	15p
18V 1W	20p
20V 400mW	15p
20V 1·3W	23p
27V 400mW	15p

Thyristors

1A 400V	75p

Electrolytic Capacitors (µF/V)

0·47/63V	8p
1·0/63V	6p
1·5/63V	6p
2·2/63V	6p
4·7/63	6p
6·8/40	6p
10/25	6p
10/63	6p
15/40	6p
22/10	6p
22/25	6p
33/6·3	6p
33/16	6p
33/40	6p
33/50	6p
47/10	6p
47/25	6p
47/40	6p
47/63	7p
100/4	6p
100/10	6p
100/25	6p
100/40	7p
100/63	13p
150/16	6p
150/63	13p
220/10	6p
220/16	7p
220/25	11p
220/40	14p
220/63	21p
330/10	6p
470/6·3	6p
470/10	12p
470/25	16p
470/40	20p
500/64	46p
680/6·3	10p
680/25	20p
680/40	25p
1000/10	14p
1000/16	25p
1000/25	30p
1000/40	54p
2200/25	45p
2200/40	71p
2800/100	390p
3300/63	133p
3300/100	390p
4700/16	60p
4700/25	75p
4700/40	93p

Polyester (µF)

0·01	3p
0·015	3p
0·022	3p
0·033	3½p
0·047	3½p
0·068	3½p
0·1	4p
0·15	5p
0·22	5½p
0·33	7p
0·47	9p
0·68	11p
1·0	14p
2·2	24p

Tantalum (µF/V)

0·1/35	12p
0·22/35	12p
0·47/35	12p
1·0/35	12p
1·5/35	16p
2·2/35	12p
4·7/35	12p
10/16	14p
10/25	16p
15/6·3	16p
22/16	16p
47/6·3	16p
47/16V	25p
100/3	16p

PRICES ARE CORRECT AT TIME OF PRESS. E. & O.E. DELIVERIES SUBJECT TO AVAILABILITY.

PHONOSONICS, DEPT. PE35, 25 KENTISH ROAD, BELVEDERE, KENT DA17 5BW

MAIL ORDER ONLY

DON'T FORGET VAT!

Practical Electronics Classified Advertisements

RECEIVERS AND COMPONENTS

7-SEGMENT LED'S. Red and Green. **£1·30** ea., 4 for **£4·50**, inc. p. & p. and VAT. C.W.O. to INDUSTRIAL ELECTRONIC SUPPLIES (STOCKPORT) LTD., 181a Bramhall Lane, Stockport, SK2 6JA.

PROBLEM GETTING AWKWARD OR UNUSUAL COMPONENTS? Let us help you find them. Also "one off" P.C.B.'s by return of post service. YORKE ELECTRONICS. Tel. 027-588 (Bitton) 2707.

COPPER CLAD FIBRE GLASS PANELS 12½in × 7in, **80p;** 18in × 4in, **70p.** Double sided 12½in × 7in, **90p;** 11in × 13in, **£1·30.** All post paid. **MC METERS,** 3 assorted 2–3in, **£1·30** (40p). **LARGE COMPUTER PANELS,** 35–50 Transistors. Lone leads, **85p** (40p). **74 SERIES D.I.L. ICs ON PANELS,** 10 for **80p** (10p). **COPPER CLAD PAX. PANELS,** 8in × 9½in, 3 for **£1.** 12½in × 9in, 2 for **90p.** 16in × 9½in, **60p.** Double sided 12½in × 12½in, **70p.** All post paid. **22-WAY STEPPING SWITCH WITH RESET.** A.C. mains operated, **£1** (30p). **THREE TRANSISTOR AUDIO AMP** Transistors equiv. to AC128, OC72, **40p** (10p). 3 for **£1,** c.p. **VALUPAKS** P9, 100 s/mica caps **55p.** P3, 10 silicon diodes 650V 1½A, **50p.** Post 12p for one. **20p** any multiple. Send 12p stamps for full list plus computer panels, etc. Refund on purchase.

7lb ASSORTED COMPONENTS £2 c.p.
3lb COMPUTER PANELS £1·75 c.p.

J.W.B. RADIO

2 Barnfield Crescent, Sale, Cheshire M33 1NL
Postage in brackets **Mail order only**

TURN YOUR SURPLUS capacitors, transistors, etc., into cash. Contact COLES-HARDING & CO., P.O. Box 5, Frome, Somerset. Immediate cash settlement.

PRECISION POLYCARBONATE CAPACITORS

ALL HIGH STABILITY—EXTREMELY LOW LEAKAGE

440V AC (±10%)		
0·1μF	(1½″×½″)	**50p**
0·22μF	(1¾″×⅝″)	**59p**
0·25μF	(1¾″×⅝″)	**62p**
0·47μF	(1¾″×¾″)	**71p**
0·5μF	(1¾″×¾″)	**75p**
0·68μF	(2″×¾″)	**80p**
1·0μF	(2″×¾″)	**91p**
2·0μF	(2″×1″)	**£1·22**

63V Range	±1%	±2%	±5%
0·47μF	**56p**	**46p**	**36p**
1·0μF	**66p**	**56p**	**46p**
2·2μF	**80p**	**65p**	**55p**
4·7μF	**£1·30**	**£1·05**	**85p**
6·8μF	**£1·64**	**£1·29**	**£1·09**
10·0μF	**£2·00**	**£1·60**	**£1·40**
15·0μF	**£2·75**	**£2·15**	**£1·90**

TANTALUM BEAD CAPACITORS—Values available: 0·1, 0·22, 0·47, 1·0, 2·2, 4·7, 6·8μF at 15V/25V or 35V; 10·0μF at 16V/20V or 25V; 22·0μF at 6V/10V or 16V; 33·0μF at 6V or 10V; 47·0μF at 3V or 6V; 100·0μF at 3V. ALL at **10p** each. 10 for **95p**, 50 for **£4**.

TRANSISTORS:					
BC107/8/9	**9p**	BC183/183L	**11p**	BFY50	**20p**
BC114	**12p**	BC184/184L	**12p**	BFY51	**20p**
BC147/8/9	**10p**	BC212/212L	**14p**	BFY52	**20p**
BC153/7/8	**12p**	BC547/558A	**12p**	AF178	**30p**
BC182/182L	**11p**	BF194	**12p**	OC71	**12p**
		BF197	**13p**	2N3055	**50p**

POPULAR DIODES—1N914 **6p**, 8 for **45p**, 18 for **90p**; 1N916 **8p**, 6 for **45p**, 14 for **90p**; 1S44 **5p**, 11 for **50p**, 24 for **£1**; 1N4148 **5p**, 6 for **27p**, 12 for **48p**; IN4001 **5½p**; IN4002 **6p**, IN4003 **6½p**; IN4004 **7p**; IN4005 **7½p**; IN4006 **8p**; IN4007 **8½p**.

LOW PRICE ZENER DIODES—400mW, Tol. ±5% at 5mA. Values available: 3V, 3·3V, 3·6V, 4·7V, 5·1V, 5·6V, 6·2V, 6·8V, 7·5V, 8·2V, 9·1V. 10V, 11V, 12V, 13V, 13·5V, 15V, 16V, 18V, 20V, 22V, 24V, 27V, 30V. 33V. ALL at **7p** each, 6 for **39p**, 14 for **84p**. SPECIAL OFFER: 100 Zeners for **£5·50**.

RESISTORS—High stability, low noise carbon film 5% ⅓W at 40°C, ⅛W at 70°C. E12 series only—from 2·2Ω to 2·2MΩ. ALL at **1p** each, **8p** for 10 of any one value, **70p** for 100 of any one value. SPECIAL PACK: 10 of each value 2·2Ω to 2·2MΩ (730 resistors) **£5.**

SILICON PLASTIC RECTIFIERS—1·5 amp, brand new wire ended DO27: 100 P.I.V. **7p** (4 for **26p**); 400 P.I.V. **8p** (4 for **30p**).

BRIDGE RECTIFIERS—2½ amp: 200V **40p**; 350V **45p**; 600V **55p**.

SUBMINIATURE VERTICAL PRESETS—0·1W only: ALL at **5p** each: 50Ω, 100Ω, 220Ω, 470Ω, 680Ω, 1kΩ, 2·2k Ω, 4·7kΩ, 6·8kΩ, 10kΩ, 15kΩ, 22kΩ, 47kΩ, 100kΩ, 250Ω, 680kΩ. 1MΩ, 2·5M, 5M.

PLEASE ADD 10p POST AND PACKING ON ALL ORDERS BELOW £5. ALL EXPORT ORDERS ADD COST OF SEA/AIRMAIL.

PLEASE ADD 8% V.A.T. TO ORDERS

Send S.A.E. for lists of additional ex-stock items.
Wholesale price lists available to bona fide companies.

MARCO TRADING

Dept. E.5, The Old School, Edstaston,
Nr. Wem, Shropshire
Tel.: Whixall 464/465 (STD 0948 72)
(Proprs.: Minicost Trading Ltd.)

GUARANTEED BRAND NEW SEMICONDUCTORS. BC107 Transistors (general purpose *npn*), **9p.** BC177 Transistors (general purpose *pnp*), **11p.** 2N3055 Transistors (high power), **45p.** 1N4004 Diode 400V PIV 1A, **5p.** IN4143 Diode, **4p.** Data sheets for each of above, **4p.** P. & P. 15p per order. VAT extra. C.W.O. All orders despatched same day. Send large S.A.E. for full lists of semiconductors, caps, res., nuts, screws, etc. NESTRA ELECTRONICS LTD., Scott Street, Bognor Regis, Sussex.

BETA DEVICES

FOR BETTER PRICES

TRANSISTORS	
AC187/8pr	0·40
BC107/ BC108	0·09
BC109C	0·11
BC113	0·14
BC126	0·13
BCY70/71/72	0·13
BFX88	0·20
BFY50	0·18
BFY51/52	0·12
2N2646	0·30
2N3053	0·14
TIP29A	0·49
TIP31A	0·61
TIP41A	0·74

DIODES	
1N914	0·04
1N4148	0·04
BY127	0·14
1N4001/2	0·05
1N5401	0·11

SGS 2N3055
£0·38
MINITRON 3015F
£1·00

D.I.L. SOCKETS	
8-Pin	0·12
14-Pin	0·12
16-Pin	0·14

ALL prices include VAT

I.C.s	
709C TO.99	0·30
709C D.I.L.	0·30
741C TO.99	0·36
741C D.I.L.	0·36
723C D.I.L.	0·80
747C D.I.L.	0·85
748C D.I.L.	0·36

BRIDGES	
1A 100V	0·20
1A 600V	0·30
20A 200V	2·00

ZENERS	
BZY88 3·3V–33V 5%	0·09

ALUMINIUM ELECTROLYTIC CAPACITORS

	10μF	22μF	47μF	100μF	220μF	470μF	1,000μF
16V	0·07	0·07	0·07	0·10	0·12	0·14	0·22
25V	0·07	0·07	0·08	0·10	0·13	0·16	0·26

C.W.O. PLUS P.P. 15p TO
BETA DEVICES
Abbey Chambers, 4 Highbridge Street, Waltham Abbey, Essex

L.E.Ds. Red **12p;** BT119 gold bonded **75p;** BT119 unmarked tested **35p;** 10A 400V thyristors 4V 35mA gate **35p;** 5A 300V **24p;** 10A 400V stud diodes **27p;** 5A 300V **22p;** numerical read out tubes type GN4A **95p;** EX-TV panels damaged some colour fantastic value 10 for **£1·65** P. & P. 65p; 10 computer panels **£1** P. & P. 30p; 10 uncompleted circuits various on veroboard **£1** P. & P. 30p. S.A.E. for lists. We have Lots of other cheap and obsolete gear in our retail shop at: INDUSTRIAL RF SERVICES, 51 Deptford Broadway, London, SE8 4PH. Tel. 01-692 4284.

VALVES 1930 TO 1975 2,000 types in stock, many obsolete. List **15p,** Transistor list **15p.** We buy new and boxed valves also transistors. COX RADIO (SUSSEX) Ltd., The Parade, East Wittering, Sussex. Tel. West Wittering 2023.

R.T. SERVICES

(MAIL ORDER ONLY)

77 Hayfield Rd., Salford 6, Lancs.

Tapped Auto Transformer, 240V-110V, 80 watts, **£1·75** P.P. New.

Tapped Auto Transformer, 240V-115V, 200 watts, **£4** P.P. New.

100 Watt Valve Output Transformer. KT88s, etc. 8 or 15Ω or 100 volt line output, **£12** P.P.

FM Tuner with R.F. Stage and A.G.C., 3 transistors, neg. earth, 2½×2×1½ in with circuit, **£1·37½** inc. P.P.

Crouzet Geared Motors, 30 r.p.m. New, **£1·54** inc. P.P.

UHF TV Tuners. Transistorised, **£1·85** inc. P.P.

Panels with I.C's on **7½p** per I.C. min. order 10 I.C's.

Transformers. 7·5V+7·5V ½A, **£1** inc. P.P. 12-0-12V, 100mA, **£1·10** inc. P.P. 9-0-9V, 100mA, **£1·10** inc. P.P. 29V 50mA, **85p** inc. P.P. 6-0-6V, 100mA, **£1·10** inc. P.P.

Transformer. 24 volt, approx. 1 amp + 6·3V CT approx. 500mA, **£1·40** inc. P.P.

Transformer. 20 volt, 1 amp, **£1·25** P.P.

Transformer. 45 volt, 2 amp, **£3** P.P.

P.C. Board. S/S, 5½×5½in, 10 for **£1** inc. P.P.

Transistorised Timer. Variable delay. 110 or 250V A.C. input. With instructions. Brand new, **£2** inc. P.P. Size 3″ × 2″ × 2″.

Power Unit Components Transformer. 18 volt 1 amp F/W bridge rectifier, 2 1250 mfd capacitors, all new **£1·40** per kit. P.P.

Electrolytic Capacitors, 4,000 MF, 50VW, 4½″ × 1¾″ **80p.** inc. P.P.

Mixed Pack of C280 series Mullard capacitors. 100 for **£1·15** inc. P.P.

4 Panels each with XN3 type Nixie tube ON **£1·85** inc. P.P. Min. order 4.

CLEARING DISTRIBUTOR STOCKS, transistors, diodes, components, etc. Sample pack **65p** incl. postage or send stamp for list. REDHAWK SALES LTD., 10 Maple Lodge Close, Rickmansworth, Herts. Mail order only.

AXIAL PRODUCTS

DEPT. 25
23 AVERY AVENUE
HIGH WYCOMBE
BUCKS.

AERIALS
4 ELEMENT FM STEREO
£3·80 + VAT + 50p P. & P.
18 ELEMENT TV
£2·00 + VAT + 50p P. & P.
10 ELEMENT TV
£1·75 + VAT + 50p P. & P.

New design, superior quality, including mounting bracket and full instructions.

AC127	20p	BCY70	18p	1N4148	4p
AC128	20p	BFY51	15p		
BC107	9p	2N2926	12p	400mV ZENER DIODES	
BC108	9p	2N3055	40p		
BC109	10p	1N4001	5p	3–33V	9p
BC113	10p	1N4002	5p	741 op amp	28p
BC148	18p	1N4003	6p	LM301 op amp	37p
BC149	18p	1N4004	6p		

ADD 8% VAT + 10p P. & P. per £ under £5
C.W.O. MAIL ORDER ONLY

BRAND NEW COMPONENTS BY RETURN, Electrolytics, 16V, 25V, 50V, 0·47, 1·0, 2·2, 4·7, 10 mF., **4p;** 22, 47, **4½p** (50V, **5p**); 100, **6p** (50V, **7p**); 220, **7p** (50V, **9p**); 500, **9p** (50V, **14p**); 1000/25V, **15p.** Subminiature bead-type tantalums, 0·1/35V, 0·22/35V, 0·47/35V, 1·0/35V, 2·2/35V, 4·7/35V, 10/20V, 22/16V, 47/6V, 100/3V, **9p.** Mylar Film 100V, 0·001, 0·002, 0·005, 0·01, 0·02, **2½p**; 0·04, 0·05, **3p**. Mullard tubular polyester 400V E6 series, 0·001, 0·022, **3p**; 0·033–0·1, **4p.** Mullard polyester 160V tubular or 250V miniature for vertical mounting, E6 series, 0·01–0·047, **3p**; 0·068, 0·1, **4p**; 0·15, 0·22, **5p**; 0·33, **6p**; 0·47, **8p**; 0·68, **10p**; 1·0, **12p**, 1·5/250V, **16p**; 2·2/250V, **19p**. Mullard miniature C333 ceramics 63V E12 series 2% 1·8 pF–47 pF, **2½p**; 56 pF–330 pF, **3p**. Plate ceramics 50V E6 series 470 pF–47,000 pF, **2p**. Polystyrene 63V, E12 series 10 pF–1,000 pF, **2½p**, 1,200 pF–10,000 pF, **3½p**. Miniature highstab. carbon film resistors ⅓W E12 series 5% (10% over 1MΩ) 1Ω–10 MΩ, **1p**; 1N4148, **3½p**; 1N4002, **5p**; 1N4006, **7p**. Postage **10p**. Prices VAT inclusive. THE C.R. SUPPLY CO., 127 Chesterfield Road, Sheffield, S8 0RN.

LED with Data clip **1p**

S dia.	0·125	0·2
RED	**15p**	**19p**
GREEN	**27p**	**33p**
YELLOW	**27p**	**33p**

D.I.L. SOCKET 8 pin **12p** 14 pin **13p**

INFRA-RED LEDs with Data **550μW axial lead, 49p** **1·5 mW TO46, £1·10**

OPTO-ISOLATORS with Data	
IL74 1·5kV, 150kHz	£1
4350 2·5kV, 5MHz	£2·25

OP. AMPS	
709 all	25p
741 8 pin	29p
748 D.I.L.	36p

THYRISTORS	50V	100V	400V
TO5 1A	**25p**	**27p**	**46p**
TO66 3A	**27p**	**35p**	**50p**

NE555V	**60p**
ZN414	**£1·10**
7400	**16p**
Dalo Pen	**70p**

Mica + bushes TO3 TO66 5p

AC127/8	**15p**	2N2926(R)	**7p**
AF117	**20p**	2N2926(G)	**12p**
BC107	**10p**	2N3053	**15p**
BC108	**9p**	2N3055	**41p**
BC109C	**12p**	2N3702/4	**12p**
BC147/8/9/	**10p**	TIS43	**25p**
BC157/8/9/	**11p**	MPF102	**40p**
BC169C	**12p**	2N3819	**25p**
BC177/8/9/	**17p**	2N3823	**30p**
BC182/3/4L	**11p**		
BC212/3/4L	**12p**		
BCY70	**15p**		
BCY71	**22p**		
BCY72	**12p**		
BFY50/51	**16p**		
OC71	**10p**		
2N706	**10p**		
2N2094/6	**16p**		

VOLTAGE REGS.	
7805 Plastic 5V 1·5A	**£1·50**
L129 Plastic 5V 600mA	**£1·40**

ZENERS BZY88	
2·7–33V	**9p**

IN914	**3p**
IN4001	**5p**
IN4002	**6p**
IN4004	**7p**
IN4148	**4p**
OA47	**6p**
OA81	**7p**
OA91	**5p**
OA95	**5p**
OA200	**6p**
OA202	**7p**

BRIDGE RECTS.	
2A 50V	**30p**
2A 100V	**36p**
2A 200V	**41p**
2A 400V	**46p**

PRICES INCLUSIVE + 15p P. & P. (1st class)

ISLAND DEVICES, P.O. Box 11, Margate, Kent

DRY REED INSERTS

Overall length 1·85" (Body length 1·1"). Diameter 0·14". Max. ratings 250v D.C. and 500 mA. Gold clad normally open contacts. **69p** per dozen; **£4·12** per 100; **£30·25** per 1,000; **£275** per 10,000. VAT and post paid.

G.W.M. RADIO LTD.
40/42 Portland Road, Worthing, Sussex 0903 34897

SERVICE SHEETS

SERVICE SHEETS, Radio, TV, etc. 8,000 models. Catalogue **20p.** S.A.E. enquiries. TELRAY, 11 Maudland Bank, Preston.

BELL'S TELEVISION SERVICES for service sheets, manuals, books on radios, T.V.s, etc. Service sheets **50p** plus S.A.E. Free book lists on request. Back issues of P.W., P.E., E.E., TV available **25p** plus 9p post. S.A.E. with enquiries: B.T.S. (Mail Order Dept.), 190 Kings Road, Harrogate, Yorks. Telephone (0423) 55885.

LADDERS

LADDERS, timber and aluminium. Tel. Telford 586644 for brochure.

FOR SALE

NCOMPLETE P.E. SYNTHESISER. Details: . MALIK, "Punjaby", Lime Walk, Dibden urlieu, Soton, Hants.

WOW AND FLUTTER METER (Tecnica WF971). Unused, as new, **£275.** Telephone IIKE YORKE 027-588 (Bitton) 2707 (daytime) or 0249 (Corsham) 713283 (evening).

OSCILLOSCOPE (Cossor CDU 110) T/B econditioned, as new, **£255.** Telephone IIKE YORKE 027-588 (Bitton) 2707 (daytime) or 0249 (Corsham) 713283 (evening).

HE PE SOUND SYNTHESISER, fully built, CB's throughout also Telly Tennis game, ully built. Offers. All letters replied. MR HANDLER, 8 Cilhaul Terrace, Mountain sh, Glamorgan, South Wales, CF45 3ND.

WANTED

TUDENT, very little time, no equipment, ould like to buy completed or almost comleted P.E. keyboard synthesiser—Offers lease. Will attempt to answer all corresondence, refunding postage. G. S. HOBSON, Grange Crescent Road, Sheffield, 11.

TOP PRICES PAID
NEW VALVES AND TRANSISTORS
Popular T.V. and Radio types
KENSINGTON SUPPLIES (B)
367 Kensington Street
Bradford 8, Yorks.

RADIO & TV SERVICING" books wanted om 1961 onwards, any quantity. **£2** paid per opy by return of post. BELL'S TELEISION SERVICES, 190 Kings Road, arrogate, Yorks. Tel. (0423) 55885.

MISCELLANEOUS

LIGHTING CONTROL UNITS

× 1½kW per channel sound-to-light converter using solated control circuitry for maximum safety. The nit comes in kit or ready built form and features ndividual sensitivity controls, sensitivity range switch nd dimming switch. (Bypass controls as an optional xtra.) Kit: **£13·99.** Ready built: **£16·99**

etails of dimmers, sequencers and other lighting ontrol units available on request.
ail order or written enquiries only to:

SELEKTRON
21 Prior's Road, Windsor, Berks. SL4 4PD

METER REPAIRS. Ammeters, voltmeters, multi-range meters, etc. Send to: METER REPAIRS, 21 Mount Road, Thundersley, Benfleet, Essex, SS7 1HA.

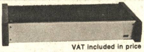
BE PROUD OF YOUR WORK AND BUILD IT IN A BEC (Book End Chassis)

PUNCHING SERVICE IF REQ'D.

Prices include VAT
P.&P. **55p**

GB1	**£4·75**	14 × 6 × 2in
GB1A	**£4·42**	9 × 6 × 2in
GB2	**£5·50**	14 × 7 × 3in
GB3	**£5·83**	14 × 9 × 4in
GB4	**£8·20**	14 × 9 × 6in

A beautifully designed modern cabinet with simulated black leatherette top (PVC bonded to metal)



VAT included in price

The **PE ORION HI-FI STEREO AMPLIFIER** uses our GB1 Bec cabinet (illustrated in Jan. 1975, Practical Electronics). Unpunched **£4·59;** Punched with lettered front panel **£6·53.**

S.A.E. with enquires please.

H.M. ELECTRONICS (PE), 275a Fulwood Road, Sheffield S10 3BD (Behind Broomhill P.O.)

DIGITAL CLOCK CHIP, AY-5-1224, with data and circuit diagram, **£3·66** plus VAT. "Jumbo" LED digits (16 mm high), type DL-747, only **£2·04** each plus VAT, post free. GREENBANK ELECTRONICS, 94 New Chester Road, Wirral, Merseyside, L62 5AG.

ENAMELLED COPPER WIRE

S.W.G.	*1lb Reel*	*½lb Reel*
10–14	**£2·05**	**£1·15**
15–19	**£2·15**	**£1·20**
20–24	**£2·20**	**£1·25**
25–29	**£2·25**	**£1·30**
30–34	**£2·35**	**£1·38**
35–40	**£2·50**	**£1·45**

All the above prices are inclusive in U.K.

COPPER SUPPLIES
102 Parrswood Rd., Withington, Manchester 20
Telephone 061-224 3553

AERIAL BOOSTERS £3·20 P. & P. 20p. We make three types of boosters: **L11-VHF radio; L12-VHF** 405 TV. Please state channel numbers. **L45-UHF** 625 TV. S.A.E. leaflets. **BARGAIN PACK POLYESTER (C280) CAPACITORS** 250V/W and 400V/W. Very good mixed selection from 0·01uF to 2·2uF. Price 100 **£1.** P. & P. 15p (our choice). LANCASHIRE MAIL ORDER, 6 William Street, Stubbins, Ramsbottom, Bury, Lancs.

CLEARING LABORATORY, scopes, recorders, testmeters, bridges, audio, R.F. generators, turntables, tapeheads, stabilised P.S.U.s, sweep generators, test equipment, etc. Lower Beeding 236.

BULK OFFERS

All goods full specification and marked
1N4001 **£2·50**/100; 1N4002 **£2·80**/100; 1N4003 **£3·20**/100; 1N4004 **£3·60**/100; 1N4005 **£4·30**/100; 1N4006 **£4·70**/100; 1N4007 **£5·00**/100; 1N914 **£3**/100; BC116A **£8**/100; BC267 **£6**/100; 741C **£19**/100; NE555V **£39**/100.
400MW Zeners, most values **£5**/100.
Assorted computer panels **£25**/cwt.
Assorted small value caps—mica ceramic, etc. **£26**/10,000.
Ferric Chloride **£30**/100 1lb bags.
Miniature mains transformers, all 100mA Sec: 6–0–6V **£5**/10; 9–0–9V **£5·50**/10; 12–0–12 **£6**/10.
½in ex-computer tape on 10½in NAB spools **£100**/100.
Veroboard offcuts 10lb **£22.**
Minimum order £5; Carriage Free. Add VAT at appropriate rate.

JUNIPER ELECTRONICS (PE1)
P.O. Box 61, Southampton

HARDWARE. Comprehensive range of screws, nuts, washers, etc. in small quantities, and many useful constructors' items. Sheet aluminium to individual requirements, punched, drilled, etc. Fascia panels, dials, nameplates in etched aluminium. Printed circuit boards for this magazine, and other individual requirements, one-off's and small runs. Machine engraving in metals and plastics, contour milling. Send 2 4½p stamps for catalogue. RAMAR CONSTRUCTOR SERVICES, Masons Road, Stratford on Avon, Warwicks. CV37 9NF.

SINTEL

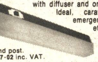
Add 10p P. & P. for orders under £2. Data, and circuits where appropriate, supplied with orders, or available separately (send 9in × 4in S.A.E.). **ADD VAT at 8%.**

Economy DL704 Red 0·3in LED 7 Segment display Common Cathode only **95p.**
DL707 Red 0·3in LED 7 segment display C. Anode **£1·35.**
NSN33 Type 0·12in 3 digit LED C.C. Red **£1·65**; 4 for **£5·00.**
MAN3M 0·12in 7 segment display Red, C.C. **48p.**
MK50250N Alarm Clock IC £5·60; CT7001 £9·80.
MK50250N plus **4 DL704 £9·20; MK50250N** plus **6 DL704 £10·95; CT7001** plus **4 DL704** only **£10·80; CT7001** plus **6 DL704 £12·70.**
PCBs for **MK50250** inc. I.C. skt. **£2·45;** PCB for **4/6 DL704 £1·35; 75492** LED dig. driver **£1·02; 75491** quad seg. drvr. **81p** (S.A.E. for cct.).
Other displays, clock and calculator I.C.s are available—Telephone (9.30 am to 7 pm) or send S.A.E. for list.
SOLDERCON IC Socket Pins 100 pins for **50p;** 300 pins for **£1·50;** 1,000 pins for **£4·00;** 3,000 pins for **£10·50** (instructions supplied). Send S.A.E. for sample.
Nylon supports available—Samples enclosed with any pin order.
RCA CMOS Data Book £1·50 (No VAT on data book).

SINTEL, 53B ASTON STREET, OXFORD. Tel. (0865) 43203

SUPERB INSTRUMENT CASE by Bazelli, manufactured from heavy duty PVC faced steel. Hundreds of radio, Electronics and Hi-Fi enthusiasts are choosing the case they require from our range of over 200 models. Largest choice at highly competitive prices, why pay more? Fast despatch. Free literature (stamp would be appreciated). BAZELLI, Department No. 25, St. Wilfrid's, Foundry Lane, Halton, Lancaster, LA2 6LT.

12 VOLT 21in 13 watt FLUORESCENT LIGHTING (by THORN/AEI) with diffuser and on/off switch. Ideal, caravan, boat, emergency lighting, etc. Guaranteed



£5·50
inc. VAT and post.
List price **£7·02** inc. VAT.

SALOP ELECTRONICS Tel. 53206
23 Wyle Cop, Shrewsbury, Shropshire

TRIACS (plastic) 10A/400V **64p** (**60p** for 3+). Diac **19p.** NE555V **58p** (**55p** for 3+). LED's 0·2 in. dia. red **20p;** amber, green, yellow, **25p.** P. & P. 10p. Add VAT. C.W.O. T. K. ELECTRONICS, 106 Studley Grange Road, London, W7 2LX.

fibre optic suppliers

MARE'S TAILS. Build a decorative display with this professionally finished unit, 22in diameter with 7,000+ fibres. Looks immaculate. **£10.**
FIBROFLEX SIZE 1. Flexible 440 strand glass light conduit, bundle dia. 1·14mm. **40p** per metre (**£3** per 10m).

FIBROFLEX SIZE 4. 2·28mm bundle dia. **£1·50** per metre (**£12** per 10m).

CROFON 1610. 64-strand plastic light conduit, bundle dia. 1·8mm, O.D. 3·3mm. **£1·20** per metre (**£9·30** per 10m).

PLASTIC OPTICAL MONOFIBRE. For multiple illumination from one source, displays, internal illumination, effects, optical coupling, etc.
FP20 (0·5mm dia.)—**50p** per 10m; **£4** per 100m.
FP40 (1mm dia.)—**£2·20** per 10m; **£14** per 100m.
FP60 (1·5mm dia.)—**£4** per 10m; **£30** per 100m.

OPTIKIT 103. Contains 2m Crofon 1610 plus 5m each FP20, FP40, FP60 plus polishing compound. A handy pack for the experimenter. **£4·70.**

LENSES AND REFLECTORS. We stock a range of 6 lenses and 5 reflectors for use in proximity detectors, intruder detectors, batch counters, tachometers, short range optical communications.

OPTIKIT L6. 1 each of 6 lenses, **£2·50.**

OPTIKIT RR5. 1 each of 5 reflectors, **£1·50.**

CIRCULAR POLARISERS. Cut that glare. Reduce specular reflection by up to 20×—enhance contrast on crts, LED displays, nixies, instruments, etc. Available in red/amber/green/neutral. 50mm square **60p;** 75mm **£1·20;** 150mm **£4.**

LINEAR POLARISERS. For light valves, stress analysis, type HN32. Type KN42 is for high temp. use in projectors. Use a pair to make a psychedelic light show. Price as for circular polarisers.

LIGHT SOURCES AND DETECTORS: MV54 Miniature (2mm) Red LED, **20p** (10+ **18p**); MLED500 TO92 Red LED, **20p** (10+ **18p**); MLED92 Infra-Red Emitter, **30p** (10+ **27p**); XC209-R 3mm Red LED, **20p** (10+ **18p**); XC209-Y or -G Yellow/Green, **30p** (10+ **27p**); 2N5777 High Sensitivity Photodarlington Silicon Detector, gain ×2,500, **50p** (10+ **45p**); MRD150 Silicon Phototransistor—high speed, 4µs good sensitivity. **70p** (10+ **67p**).

****NEW MLS203.** Latest Motorola Light Activated SCR. High sensitivity 10mW/cm²; high current 400mA (5A peak); 60V. Switch small motors or relay direct from optical control, up to 24W power. **£1·20** (10+ **£1·10**).

SEO5B ULTRASONIC TRANSDUCER. For remote control 40kHz. Tx/Rx pair, **£3·50.**

Please add 8% VAT to prices above
Send 9in × 6in S.A.E. for short form list.

FIBRE OPTIC SUPPLIERS
(Dept. PE), 2 Loudoun Road Mews
London NW8 0DN
(Please note change of address)

MISCELLANEOUS
CONTINUED PAGE 446

EDUCATIONAL

C AND G EXAMS

Make sure you succeed with an ICS home study course for C and G Electrical Installation Work & Technicians, Radio/TV/Electronics Technicians Telecomms Technicians and Radio Amateurs.

COLOUR TV SERVICING

Make the most of the current boom! Learn the techniques of servicing Colour and Mono TV, sets through new home study courses, approved by leading manufacturers.

TECHNICAL TRAINING

Home study courses in Electronics and Electrical Engineering, Maintenance, Radio, TV, Audio, Computer Engineering and programming. Also self-build radio kits. Get the qualifications you need to succeed.

Free details from:

INTERNATIONAL
CORRESPONDENCE SCHOOLS
Dept. 730, Intertext House, London
SW8 4UJ
Or phone 01-622 9911 (All hours)

TELEVISION TRAINING

16 MONTHS' full-time practical and theoretical training course in Radio and TV Servicing (Mono and Colour) for beginners.

13 WEEKS' full-time Colour TV Servicing course. Includes 100 hours practical training. Mono revision if necessary. Good electronics background essential.

NEXT SESSION commences on April 21st.

Prospectus from London Electronics College, Dept. A5, 20 Penywern Road, London SW5 9SU. Tel. 01-373 8721.

SITUATIONS VACANT

MEN! £90 p.w. can be yours

Jobs galore! Tens of thousands of new computer personnel needed over the next few years alone. With our revolutionary, direct-from-America, course, you train as a Computer Operator in only 4 weeks!

It can pay around £35 p.w. as a starter and can reach over £90 p.w.

After training, our exclusive appointments bureau — one of the world's leaders of its kind — introduces you FREE to world-wide opportunities. Write or 'phone TODAY, without obligation.

London Computer Operators Training Centre **Y35, Oxford Hse.**
9-15 Oxford St., W.1. Tel. 01-734 2874

APPOINTMENTS

ELECTRONIC CRAFTSMEN

Is your present job routine and uninteresting?

We are a research establishment and our craftsmen are engaged on a wide variety of work in the fields of prototype and small batch wiring and assembly, test and inspection, maintenance fault finding and repair. Why not join us and enjoy working in first class conditions in the country.

You can expect gross earnings including overtime of £45 per week, and we can offer good housing at low rental (for applicants who reside outside the radius of our Assisted Travel Area) together with 3 weeks' paid holiday with holiday bonus, free pension and excellent sick benefit scheme.

Applicants who should have served a recognised apprenticeship or have had equivalent training together with experience in one of the fields detailed should 'phone Tadley 4111 (STD 073-56 4111) Ext. 5230, or write to:

Industrial Recruitment Officer
(PA/77/PE) Procurement Executive
Ministry of Defence
AWRE Aldermaston
Reading, Berks. RG7 4PR

ELECTRONICS VACANCIES

Ministry of Defence Experimental Establishment in the Lake District requires experienced electronics mechanics to build, develop and diagnose a wide range of instrumentation.

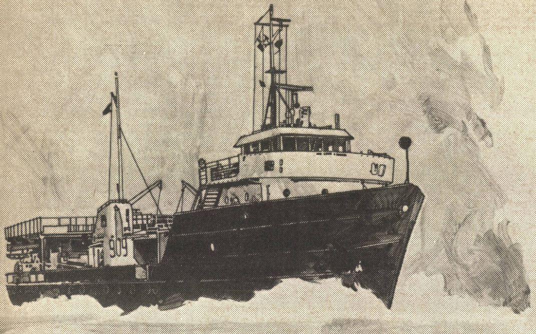
Rate of pay for 40 hour, 5 day week £33·41 plus Productivity Bonus of £4 and Cost of Living Allowance of £4·40 per week.

The posts are pensionable, there is a sick pay scheme, three weeks' annual paid holiday and an assisted travel scheme. There is a prospect of housing accommodation within a reasonable period for a married man, hostel accommodation is immediately available for single men.

If you have served a recognised apprenticeship or have had equivalent service training and would like to work in a beautiful part of the country, send for an application form to:

Personnel Officer
Ministry of Defence (Procurement Executive)
Eskmeals
Bootle Station
CUMBRIA LA19 5YR

Telephone: Ravenglass 214/5/6



Oil Exploration

G.S.I. Ltd, a subsidiary of Texas Instruments requires technicians with approximately four years experience in maintenance and repair of digital and analogue electronic equipment and qualified to ONC/HNC or City & Guilds (F.T.C.).

The openings available are in overseas marine seismic operations and are based on a 26 month contract with opportunities for home leave during this period.

The type of people we are looking for are single men who want a career that involves travel, work on shipboard Texas Instruments navigation and seismic digital recording equipment but will still be prepared to get their hands dirty.

If you feel that you fit the qualifications listed and are looking for a job that is not "9 a.m. to 5 p.m." contact David Kennedy, Personnel Department, G.S.I. Ltd, Canterbury House, Sydenham Road, Croydon, Surrey. Tel : 01-686 6511, ext 257.

Geophysical Service International Ltd.

MISCELLANEOUS CONT'D

P.E. MINISONIC HOUSING with ready drilled front panel teak finish, **£5·50** inclusive p. & p. Other cabinets built on request and specification from: D. M. BAILEY, 49 The Glen, Rainham, Essex.

IC SOCKET PINS for low cost mounting of 8 to 40 pin DILs. **50p** (+ 4p VAT) for strip of 100, **£1·50** (+ 12p VAT), for 3 × 100, **£4** (+ 32p VAT) for 1,000. Instructions supplied—send S.A.E. for sample. 10p P. & P. for orders under £2. SINTEL, 53b Aston Street, Oxford. Tel. 0865 43203.

STEREO Pickup Pre-amp RIAA.

Suitable p.u.'s 2-10mv output. Features ultra low noise IC 70dB. type. Max. output up to 1v. rms. (dep. on input). Frequency Response 20Hz-100KHz. Mains powered for easy installation.

£5·95 incl. VAT. P. & P. 15p.

S.A.E. for details of other modules.

P. F. STEVENS Electro-Acoustics
8A CLARENCE ROAD
SOUTH BENFLEET, ESSEX

LOW COST I.C. MOUNTING. 100 I.C. pin sockets **60p.** Quantity rates. S.A.E. details and sample. 7 and 8 hole plastic supports **5p**/pair. (P. & P. 5p/order). LED (MLED500) **20p** each post free. Quantity rates. P.K.G. ELECTRONICS, Oak Lodge, Tansley, Derbyshire, DE4 5FE.

MINI ACCUMULATORS

2 volt MULTI-USE Sealed Lead Acid Rechargeable Cells.

Size L450—1·4" x 1·1" x 0·44". 3 for £1·85 inc. P. & P.

Size GA2—1·7" x 1.3" x 0·5". 3 for £2·35 inc. P. & P.

GARFIELDS, 269 Rye Lane, London, S.E.15

PRINTED CIRCUIT BOARDS. Manufacturer's offer: PCB's for ALL "P.E. and P.W." projects published after June, 1974, at ONE price, **70p** each. Any 5 **£2·85.** PRODUCTION SPACE available for: PCB Production, PCB and Electronic Design to Spec.: electroplating, silk-screening, roller and electro tinning. All art-work and photography undertaken. Send basic circuit, P.C layout or P.C. master stating quantity required for estimate by return, or phone: W.K.F. ELECTRONICS, Dept. P.C., Welbeck Street, Whitwell, Worksop, Notts., S80 4TW. Tel.: Whitwell (Derbys.) 695.

BUILD THE

TREASURE TRACER MK III Metal Locator

- Varicap tuning
- Britain's best selling metal locator kit
- Weighs only 22oz.
- Speaker and earphone operation
- Knocks down to only 17in.
- Prebuilt search coil assembly
- Five transistor circuit
- Thoroughly professional finish
- You only need soldering iron, screwdriver, pliers and snips
- As seen on BBC-1 & BBC-2 TV

Send s.a.e. for leaflet

Complete kit **£9·80** P. & P. 60p + 78p VAT

Built, tested and guaranteed **£13·75** P. & P. 60p + £1·10 VAT

MINIKITS ELECTRONICS, 6g CLEVELAND ROAD, LONDON E18 2AN (Mail Order Only)

FANTASTIC NEW MICROTEST 80

MEASURES ONLY
90 × 70 × 18mm
ELECTRONIC ZERO Ω

Amazing Value at £11·95

8 fields of measurement and 40 ranges

PRINTED CIRCUIT BOARD IS REMOVABLE WITHOUT SOLDERING

Volts d.c. 6 ranges: 100mV, 2V, 10V, 50V, 200V, 1,000V (20kΩ/V). 2% precision on d.c. and a.c.
Volts a.c. 5 ranges: 1·5V, 10V, 50V, 250V, 1,000V (4kΩ/V).
Amp. d.c. 6 ranges: 50µA, 500µA, 5mA, 50mA, 500mA, 5A.
Amp. a.c. 5 ranges: 250µA, 2·5mA, 25mA, 250mA, 2·5A.
Ohms 4 ranges: Low Ω, Ω × 1, Ω × 10, Ω × 100 (from 1/10 di Ω until 5MΩ).
V Output 5 ranges: 1·5V, 10V, 50V, 250V, 1,000V.
Decibels 5 ranges: +6dB, +22dB, +36dB, +50dB, +62dB.
Capacity 4 ranges: 25µF, 250µF, 2,500µF, 25,000µF.

SUPERTESTER 680R ICE

20,000 Ohm per Volt sensitivity ● Fully screened against external magnetic fields ● Scale width and small case dimensions (128 × 95 × 32mm) ● Accuracy and stability (1% in D.C., 2% in A.C.) of indicated reading ● Simplicity and ease of use and readability ● Full ranges of accessories ● 1,000 times overload ● Printed circuit board is removable without de-soldering ● More ranges than any other meter. Ask for free catalogue.

£18·50
Accessories Extra

Accessories (extra) available to convert Microtest 80 and Supertester 680R into following: LIGHTMETER, GAUSS METER, ELECTRONIC VOLTMETER, AMPER-CLAMP, TRANSISTOR TESTER, TEMPERATURE PROBE, PHASE SEQUENCE INDICATOR, Ω × 100kΩ Multiplier, SIGNAL INJECTOR—Send for details.

MORE RANGES FOR LESS MONEY!

AC/DC Multimeter type U4324

A-DC 0·06–3A–6 Ranges.
A-AC 0·3–3A–5 Ranges.
V-DC 0·6–1200 V–9 Ranges.
V-AC 3–900 V–8 Ranges.
Frequency in the range of 45 to 20kHz. Resistance: 500 ohm to 5 Mohm—5 ranges. Decibel: −10 to +12dB. Accuracy: ±2·5%. DC +4% AC. Dimensions: 167 × 98 × 63mm.

Only **£8·85**

ALPHANUMERIC NIXIE TUBES B7971

The Alphanumeric NIXIE tube has the ability to display all the letters of the alphabet, numerals 0 thru 9 and special characters in a single tube. From the standpoint of both readability and electrical characteristics, the Alphanumeric NIXIE tube provides many unique benefits including ★ 170V–21mA ★ All d.c. operation ★ Uniform, continuous line characters of equal height ★ Memory with simple solid state drive circuits ★ Readability in high ambient light . . . 200 footlamberts brightness ★ Long life with no loss of brightness ★ Character height 2½in.

Bases for above **60p** each.

Price only 99p each plus 16p P./P.

JUST ARRIVED! !

NUMERIC INDICATOR TUBES

Ultra-long life, high quality, 0–9 and 2 independent decimal points. Supply voltage 200V d.c. Current 14mA. Pulse duration 100µs. Character height 0·51, overall size 1·4.
Brand new, guaranteed. Surplus to manufacturer's requirements. Type B5853st

1–25 **£1·00;** 25+ **90p;** 100+ **80p;** 1,000+ price on application.

Add 8% VAT to all items + 35p P. & P.
ELECTRONIC BROKERS LTD.
49–53 Pancras Road, London NW1 2QB
Tel. 01-837 7781

EVEREST INSTRUMENTS LIMITED

34 Shakespeare Street, Nottingham
Tel. (0602) 45466

All prices quoted include P. & P. and VAT. Min. order £1, C.W.O. only. 12 × 10in. S.A.E. for full lists. Trade enquiries invited.

TRANSFORMERS

6·3V	1·5A	**£1·66**
6·3V	3·0A	**£1·90**
9·0V	1·0A	**£1·66**
12·0V	1·5A	**£1·90**
12·0V	3·0A	**£2·74**
·6–0–6V	0·5A	**£1·78**
9–0–9V	0·5A	**£1·78**
9–0–9V	1·0A	**£2·03**
10–0–10V	2·0A	**£2·73**
12–0–12V	1·0A	**£2·02**
12–0–12V	2·0A	**£2·85**
12–0–12V	3·0A	**£3·93**
15–0–15V	1·0A	**£2·62**
18–0–18V	2·0A	**£3·93**
0–10–12–14–16–18V	4·0A	**£4·17**
0–5–20–30–40–60V	2·0A	**£5·95**
Battery charger transformers 6V and 12V		
	1·0A	**£2·14**
	2·0A	**£2·98**
	4·0A	**£3·93**
240/110V autos	30W	**£2·62**
	50W	**£3·33**
	100W	**£4·76**
	150W	**£6·07**
	200W	**£7·85**
	600W	**£15·47**
Bulk tape eraser		**£3·21**
15–8–3 ohm 12W matching		**£1·55**
Transistor driver 4 : 1 + 1		**24p**

P.C. BOARD

Single sided s.r.b.p.	**50p/sq.ft**
Single sided fibre glass	**65p/sq.ft**
Double sided fibre glass	**90p/sq.ft**

(Cut in multiples of 6in, i.e. 6 × 6, 6 × 12, 12 × 12, 12 × 18)

Circuit etchant 250ml	**50p**
1lb Ferric chloride	**50p**

ELECTROLYTICS

Tubular with axial leads except where stated.

47mF	4V	**7p**	200mF	25V	**11p**
100mF	4V	**7p**	470mF	25V	**15p**
330mF	4V	**7p**	1250mf†	25V	**24p**
33mF	6·3V	**7p**	5000mF†	25V	**65p**
68mF	6·3V	**7p**	1000 +		
470mF	6·3V	**9p**	1000mF†	30V	**32p**
1000mF*	6V	**11p**	2500mF†	30V	**40p**
22mF	10V	**7p**	6·8mF	40V	**7p**
25mF	10V	**7p**	15mF	40V	**7p**
47mF	10V	**7p**	100mF	40V	**9p**
100mF	10V	**7p**	1000mF†	50V	**35p**
220mF	10V	**7p**	1mF	63V	**7p**
330mF	10V	**9p**	2·2mF	63V	**7p**
15mF	16V	**7p**	4·7mF	63V	**7p**
33mF	16V	**7p**	10mF	63V	**7p**
68mF	16V	**7p**	15mF	63V	**7p**
220mF*	16V	**9p**	22mF	63V	**7p**
330mF	16V	**12p**	32mF	63V	**9p**
1000mF	16V	**20p**	800mF†	63V	**32p**
10mF	25V	**7p**	2500mF†	63V	**85p**
22mF	25V	**7p**	4700mF†	63V	**145p**
47mF	25V	**7p**			
100mF	25V	**7p**			
150mF	25V	**9p**			

* *Single end p c fitting*
† *Single end can*

Oddments to clear:

50mF at 50V tubes	**6p**
250mF at 60V cans	**10p**
300mF at 10V p/c	**5p**
60 + 250mF at 350V cans	**30p**
0·03mf at 200V tantalum	**5p**

SPEAKERS

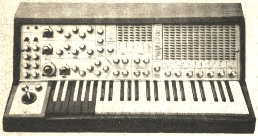
2½in EMI 8 ohm tweeter 97492AT	**84p**
3in Goodmans 8 ohm tweeter 51C4D	**£1·43**
3in Audax 8 ohm tweeter 6·5TWBi8	**£1·55**
5in Audax 8 ohm bass HIFIE8	**£4·17**
5in EMI 8 ohm bass 3472BW	**£5·36**
5in EMI 8 ohm 14A/564B	**£1·19**
6½in EMI d/cone 8 ohm 93850CC	**£4·64**
7 × 4in EMI 15 ohm 99950AN	**£1·79**
8 × 5in EMI d/cone 4 or 8 ohm 10 watt	**£3·22**
10 × 6in EMI 8 ohm 93870KG/H	**£2·26**
10 × 6in EMI 8 ohm mid-range 93870CH	**£5·36**
10 × 6in EMI 8 ohm 20 watt	**£11·90**
10 × 6in Elac 8 ohm d/cone 610RM59	**£3·57**
8in Elac 8 ohm 8RM/306	**£3·57**
8in Celestion 8 ohm d/cone PS8 9858	**£3·57**
12in EMI 25 watt 8 ohm 14A/1200CP	**£13·69**
13 × 8in EMI 20 watt 8 ohm 92390GK/H	**£6·55**
13 × 8in EMI 25 watt 8 ohm 92390GF/H	**£10·12**

MISCELLANEOUS

SWR 10 swr single meter	**£8·20**
SWR 50 swr and power twin meter	**£12·20**
Illuminated (12V) edge meter 130µA	**£1·95**
5 × 7 led alpha numeric matrix 14 dil	**£3·00**
BB113 triple varicaps	**30p**
Dual reed relays 35 ohm coil 2 reeds N.O.	**40p**
BC177 complementary to BC107	**20p**
AC128	**18p**
10kΩ lin stereo pots	**39p**
100kΩ log stereo pots plus D.P. switch	**45p**
250 ohm lin pots plus S.P. switch ¼in shaft	**20p**
110V solenoids	**25p**
8280A BCD decade counter	**£1·05**
Twin tuning 300 + 250pF with ganged 100kΩ pot for varicap tuning	**40p**
3·7–70pF disc compression trimmers	**8p**
0·47mF at 100V polycarbonate	**10p**
1·0mF at 100V polycarbonate	**12p**
0·01mF at 160V tubular polyester	**4p**
0·04mF at 600V	**4p**
0·0033mF at 1500V	**4p**
250ml plastic bottles for etching solution	**15p**
250V C280 Capacitors:	
0·01, 0·015, 0·022, 0·047	**2p**
0·1	**3p**
0·33	**6p**
1·0	**12p**
2·2	**20p**

SYNTHESISER

Modules by *Dewtron®*



The synthesiser illustrated was built using Dewtron modules, as sold to constructors for some years now. With over 10 years' experience in mail-order, we have supplied many famous people and groups. Over 30 types of synthesis modules, some of extremely precision design, e.g. VCO–2 log-law oscillator; 3-wave o/ps; sample/hold/envelope module; pitch-to-voltage module allowing a whole equipment to "play itself" in unison/harmony with any solo input or voice. Modules for sequencer construction, too. Famous "Modumatrix" patching system makes other patching a thing of the past! Send just 15p for full catalogue to:

D.E.W. LTD.

254 Ringwood Road, Ferndown
Dorset BH22 9AR

P.E. ORION

Complete kit of semiconductors £9.95
High quality printed circuit £2.95

THIS GLASS FIBRE P.C.B. IS ROLLER TINNED AND SCREEN PRINTED WITH COMPONENT LOCATIONS.

FERRANTI semiconductors

BFS59	18p	ZTX304	29p	ZTX504	55p	ZS170	14p
BFS60	21p	ZTX310	12p	ZTX510	25p	ZS171	16p
BFS61	21p	ZTX311	14p	ZTX530	29p	ZS172	22p
BFS96	19p	ZTX312	14p	ZTX531	34p	ZS174	26p
BFS97	23p	ZTX313	16p	ZTX550	25p	ZS176	33p
BFS98	23p	ZTX314	17p	ZTX551	27p	ZS178	58p
ZTX107	12p	ZTX330	21p	2N3055	76p	ZS270	15p
ZTX108	9p	ZTX331	23p			ZS271	22p
ZTX109	14p	ZTX382	15p	*** DIODES ***		ZS272	25p
ZTX212	14p	ZTX383	19p	ZS120	15p	ZS274	29p
ZTX213	15p	ZTX384	23p	ZS121	16p	ZS276	38p
ZTX214	19p	ZTX450	23p	ZS122	19p	ZS278	61p
ZTX239	16p	ZTX451	25p	ZS123	25p		
ZTX300	16p	ZTX500	16p	ZS124	29p	*** ZENERS ***	
ZTX301	17p	ZTX501	17p	ZS140	26p	KSO30A to	
ZTX302	23p	ZTX502	23p	ZS141	40p	KS180A	28p
ZTX303	18p	ZTX503	18p	ZS142	39p	BZV19 series	15p

MOTOROLA BD699 **£1·10**, BD700 **£1·22**, MJE2955 **£1·30**, MJE3055 **75p.**

SIGNETICS UA748CV operational amplifier **55p** each.

RCA PRICES SLASHED! CA3090Q stereo decoder only **£3·25** each.

ZN414 THE FAMOUS FERRANTI RADIO I.C. Only **£1·32** with data.

SCORPIO Mk. II. Complete kit of semiconductors **£5·65** (State 6V or 12V).

ALL DEVICES SOLD BY US ARE TOP GRADE, BRAND NEW AND TO FULL MANUFACTURER'S SPECIFICATION. We do not sell seconds or rejects. We are specialists in FERRANTI semiconductors and can supply any device to order. S.A.E. for quote. Send S.A.E. for our free data sheet and price list for FERRANTI semiconductors.

POSTAGE AND PACKING 10p. FREE ON ORDERS OVER £3
ALL OUR PRICES INCLUDE VAT

DAVIAN ELECTRONICS

PO BOX 38, OLDHAM, LANCS, OL2 6XJ

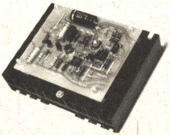
---

hurst®

ELECTRONICS

92 Warwick Road, Ealing, London W5 5PT
Telephone: 01-567 0424

HE 100
100 WATT POWER AMP MODULE



- ★ Includes large black anodised heatsink—no further heatsinks required.
- ★ Top grade glass-fibre P.C.B.
- ★ Uses high quality components.
- ★ Fully protected—short/open circuit proof.
- ★ Only 5 external connections.
- ★ Fully guaranteed.

TECHNICAL SPECIFICATIONS

★ Power output	: 106W R.M.S. into 8Ω
★ Distortion	: 0·8% at full O/P. Typ. 0·4%
★ Frequency response	: 15Hz–23kHz
★ Signal to noise	: Better than –96dB
★ Input sensitivity	: 0dB (0·775V)
★ Input impedance	: 10kΩ
★ Supply volts	: 45–0–45V

Price **£20·64** inc. VAT/P. & P.

HE300 (POWER SUPPLY FOR HE100)
Price **£12·95** inc. VAT/P. & P.

NOTE: Power supply HE300 supplied only in kit form. Power supply cannot be supplied with transformer outside United Kingdom. Cost less transformer: **£7·25.**

CASED AMPLIFIERS (Slave type for P.A. and disco use).
PRX100, 100W Mono, **£75·06** (inc. VAT)
PRX200, 200W Mono, **£142·51** (inc. VAT)
PRX100S, 100W per channel stereo, **£142·51** (inc. VAT)
PRX200S, 200W per channel stereo, **£253·80** (inc. VAT)

Front panels complete with in/out sockets and level control, etc. for use with modules. Please ask for details.

TTL I.C.s

		7430	14p	7476	34p
7400	13p	7441	65p	7480	65p
7401	14p	7442	65p	7486	34p
7402	14p	7447	85p	7489	300p
7403	16p	7448	70p	7490	40p
7404	18p	7450	18p	7491	70p
7408	16p	7454	18p	7492	45p
7410	14p	7460	18p	7493	40p
7413	32p	7470	30p	74107	37p
7414	72p	7472	25p	74121	30p
7416	33p	7473	32p	74122	76p
7420	14p	7474	32p	74123	70p
		7475	40p	74141	70p

ACCESSORIES DIL SOCKETS (L.P.)
8 pin **12p,** 14 pin **13p,** 16 pin **14p.**
Mica + bushes for TO3 and TO66 6p.

5314 Clock Chip 24 pin DIL **650p.**
Alarm Clock Chip 40 pin DIL (similar MM5316) **750p.**
5001 12 Digit Calculator Chip 28 pin DIL **485p.**
(All above supplied with full data; data separately **25p** each + S.A.E.)
PC Keyboard (0–9, decimal, 4 function, C, K, keys). Size: 2·36″ × 3·76″ × 0·45″ **400p.**

Popular Op Amps

709	OPA with ext. comp.	28p
710	Diff. comparator	40p
741	**OPA with int. comp. (8 pin DIL)**	23p
747	Dual 741	70p
748	OPA with ext. comp.	38p

LINEAR I.C.s

CA3046	**Transistor Array**	50p
CA3048	4 Independent Amplifiers	230p
LM301A	Op. Amp. with ext. comp.	36p
LM380	Audio Amplifier	90p
LM381	Stereo Pre Amp.	150p
LM3900	Quad Op. Amp.	70p
MC1310	**Coilless FM Stereo Dec.**	210p
MC1312	SQ Quadraphonic Dec.	220p
MC1314	SQ Quadraphonic Dec.	360p
MC1315	SQ Quadraphonic Dec.	430p
MFC4000	½W Audio Amp.	50p
MFC6040	Electronic Attenuator	90p
MFC8070	Zero Voltage Switch	250p
NE536	FET Op. Amp.	280p
NE555	**Timer 8 pin DIL**	50p
NE556	Dual 555 14 Pin DIL	100p
NE560	PLL 16 Pin DIL	325p
NE561	PLL with AM Demod. 16 pin	370p
NE562	PLL with VCO 16 Pin	325p
NE565	PLL 14 Pin DIL	290p
NE566	Function Generator 8 Pin DIL	200p
NE567	**PLL Tone Decoder 8 pin DIL**	250p
TBA570	AM/FM Radio receiver	160p
TBA800	5 Watt Audio Amp.	90p
TBA810	7 Watt Audio Amp.	100p
TBA820	2 Watt Audio Amp	80p
ZN414	TRF Radio Receiver	110p
ICL8038	**Voltage Controlled Osc. 14 pin DIL**	275p

Data sheets on above I.C.s **10p** each.

BRIDGE RECTIFIERS

	50V	100V	400V	600V
250mA	18p	—	—	—
1 Amp	22p	24p	27p	29p
2 Amp	30p	35p	45p	48p
4 Amp	—	—	—	—
6 Amp	55p	60p	78p	—

SCR—THYRISTORS

	50V	100V	400V	600V
1 Amp	40p	45p	55p	72p
3 Amp	43p	49p	75p	100p
7 Amp	—	80p	84p	—
16 Amp	—	82p	98p	—

Other
C106D **45p,** 2N3525 **91p,** 2N4444 **185p**

TRIACS

	100V	400V	500V
3 Amp	85p	95p	120p
6 Amp	88p	120p	150p
10 Amp	109p	154p	165p
16 Amp	145p	180p	200p

Other
40430 **90p,** 40486 **85p,** 40669 **95p.**
DIAC for use with above triacs **21p.**

VOLTAGE REGULATORS

723
14 pin DIL **45p**

MFC4060 **70p**

1 Amp	Plastic	
7805	5V	140p
7812	12V	140p
7815	15V	140p
7818	18V	140p
7824	24V	140p

AC126/7	11p	BC212	11p	OC35	48p	2N1308/9	28p
AC128	11p	BC213	10p	OC36	52p	2N1613	20p
AC176	11p	BC214	13p	OC41/2	15p	2N1711	20p
AC187	12p	BD115	55p	OC44/5	11p	2N2219	20p
AC188	11p	BD124	75p	OC70/1/2	11p	2N2221/2	20p
AD149	43p	BD131	42p	OC73	60p	2N2369	14p
AD161	36p	BD132	45p	OC81/2	12p	2N2484	30p
AD162	36p	BF115	22p	OC83/4	28p	2N2904	20p
AF114/5	13p	BF167	23p	TIP2955	70p	2N2905	18p
AF116/7	13p	BF173	25p	TIP41A	65p	2N2926RB	8p
AF139	41p	BF184	22p	TIP42A	70p	2N29260	8p
AF239	44p	BF194	10p	ZTX300	12p	2N2926YG	9p
BC107/8	9p	BF195	10p	ZTX304	24p	2N3053	18p
BC109	10p	BF196	12p	ZTX500	15p	2N3054	40p
BC147/8	7p	BFR39/40	28p	ZTX504	50p	2N3055	49p
BC149	9p	BFR41	28p	2N696	15p	2N3442	140p
BC157	13p	BFX29/30	30p	2N697	13p	2N3702/3	11p
BC158	12p	BFY50/1/2	15p	2N698	30p	2N3704/5	11p
BC159	14p	BRY39	34p	2N706	12p	2N3706/7	11p
BC169C	12p	MJE340	45p	2N708	18p	2N3708/9	9p
BC177	18p	MJE2955	99p	2N930	18p	2N3772	161p
BC178	17p	MJE3055	65p	2N1131/2	18p	2N3773	220p
BC179	18p	MPSU06	58p	2N1302/3	17p	2N3903/4	15p
BC182/3	10p	OC26	47p	2N1304/5	21p	2N3905/6	15p
BC184	11p	OC28	55p	2N1306/7	28p	2N4058	15p

2N4060	13p
40361	40p
40362	43p
UJTS	
TIS43	25p
2N2160	70p
2N2646	35p
2N4871	31p
FETS	
BF244	36p
MPF102/3	30p
MPF104/5	30p
2N3819	20p
2N3820	57p
2N3823	50p
2N5457	30p
2N5458	30p
2N5459	30p
MOSFETS	
40603	58p
40673	56p
3N128	75p
3N140	85p
3N141	75p

C-MOS I.C.s

CD4001AE	23p
CD4011AE	23p
CD4012AE	23p
CD4013AE	67p
CD4016AE	90p
CD4017AE	183p
CD4023AE	23p
CD4024AE	148p
CD4025AE	23p
CD4027AE	108p
CD4030AE	82p
CD4046AE	225p
CD4047AE	154p

OPTO-ELECTRONICS
LDR ORP12 **50p,** ORP60 **60p;** Trans OCP71 **85p,** 2N5777 **40p.**

LEDS TIL209 (Red) **16p,** Green/Yellow **35p.**

Seven Segment Displays

Filament			
3015F	0·354in	DIL	120p
All LED			
MAN–3M	0·127in	PCB	120p
MAN–4	0·19in	DIL	180p

Reflective Bar LED

LIT 704	0·33in	DIL	100p
LIT 707	0.33in	DIL	135p
LIT 747	0·63in	DIL	200p

3 Digit Readouts

Blisdor Lens	0·127in	DIL	250p
Red Lens Filter	0·127in	DIL	185p

DIODES

BY100	15p	OA200	6p
BY126	12p	OA202	7p
BY127	12p	1N914	4p
OA47	7p	1N4001	5p
OA79	7p	1N4004	6p
OA81	7p	1N4007	7p
OA85	9p	1N4148	4p
OA90	6p		
OA91	6p	**Tunnel**	
OA95	7p	AEY11	50p

ZENERS
3·3V to 33V

400MW	9p
1·3W	18p
1·5W	30p
Varicap	
BB105	30p
Noise	
Z1J	75p

New I.Cs
NE563 High Performance PLL FM IF Demod
Requires minimum effort to make high quality FM tuner
16 pin DIL £3
CA3130 COS MOS Operational Amplifiers with MOS FET Input
Ideal for single-supply applications
8 DIL Formed Leads in TO-5 £2
Data **20p** each + S A E

Minimum order £2.
All prices exclusive of VAT.
P. & P. **15p.**

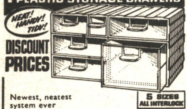
Government, Colleges

MAIL ORDER ONLY

TECHNOMATIC LTD.

54 Sandhurst Road, London NW9. Tel. 01-204 4333

I-N-T-E-R-L-O-C-K-I-N-G PLASTIC STORAGE DRAWERS



Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots. ID and 2D have space dividers. Build up any size cabinet for wall, bench or table top.

BUY AT TRADE PRICES!

SINGLE UNITS (ID) (5ins × 2¼ins × 2¼ins). **£2** DOZEN.

DOUBLE UNITS (2D) (5ins × 4½ins × 2¼ins). **£3·50** DOZEN.

TREBLE (3D) £3·50 for 8.

DOUBLE TREBLE 2 drawers, in one outer case **(6D2), £4·90** for 8.
EXTRA LARGE SIZE (6D1) £4·50 for 8.

PLUS QUANTITY DISCOUNTS!
Orders £15 and over DEDUCT 5% in the £
Orders £30 and over DEDUCT 7½% in the £

PACKING/POSTAGE/CARRIAGE: Add 40p to all orders under £10. Orders £10 and over, packing/postage/carriage free.

QUOTATIONS FOR LARGER QUANTITIES

Please add 8% V.A.T. to total remittance

FLAIRLINE SUPPLIES (Dept. PE5), 124 Cricklewood Broadway, London, N.W.2
Tel. 01-450 4844

OSMABET LTD

We make transformers amongst other things

AUTO TRANSFORMERS 110–200/220/240V 30W, **£2·10;** 50W, **£2·70;** 75W **£3·45;** 100W, **£4;** 500W, **£12;** 750W, **£16·50;** 1000W, **£20·25,** etc.

LOW VOLTAGE TRANSFORMERS
Prim. 200/240V a.c. 6·3V 1·5A, **£1·45;** 3A, **£1·80;** 6A, **£3·60;** 12V 1·5A, **£1·80;** 3A, **£3·30;** 6A CT, **£4·50;** 18V 1·5A CT, **£3·30;** 24V 1·5A CT, **£3·30;** 3A CT, **£4·50;** 5A, **£6·75;** 8A, **£8·70;** 12A, **£12·40;** 40V 3A CT, **£6;** 50V 6A CT, **£15·75;** 25V 2A + 25V 2A, **£6·40;** 12V 4A + 12V 4A, **£6·40.**

LT TRANSFORMERS TAPPED SEC, Prim 200/240V
0–10–12–14–16–18V 2A, **£3·30;** 4A, **£4·50.**
0–12–15–20–24–30V 2A, **£4·20;** 4A, **£6.**
0–5–20–30–40–60V 1A, **£4·20;** 2A, **£6.**
0–40–50–60–80–90–100–110V 1A, **£6·40.**

MIDGET RECTIFIER TRANSFORMERS
For FW rect., 200/240V a.c. 6–0–6V 1·5A or 9–0–9V 1A **£1·65 each;** 12–0–12V 1A or 20–0–20V 0·75A or 9-0-9V 0·3A or 12–0–12V 0·25A or 20–0–20V 0·15A or 6V 0·5A + 6V 0·5A or 9V 0·35A + 9V 0·35A or 12V 0·25A + 12V 0·25A or 20V 0·15A + 20V 1·5A, **all at £1·90 each.**

MAINS TRANSFORMERS
Prim. 200/240V a.c. TX6 sec., 425–0–425V 500 MA, 6·3V CT 6A, 6·3V CT 6A, 0–5–6·3V 3A **£18·75;** TX1 425–0–425V 250 MA, 6·3V CT 4A, 6·3V CT 4A, 0–5–6·3V 3A, **£11·25;** MT3 Prim. 0–110–240V, sec., 250V 100 MA, 6·3V 2A, E/S, **£3·75.**

O/P TRANSFORMERS FOR POWER AMPLIFIERS
P.P. sec., tapped 3–8–15 ohms, A–A 6·6kΩ 30W **£6·75;** A–A 3kΩ 50W **£10·15;** 100W (EL34 KT88, etc.), **£17·25;** MRT/10, tapped multi O/P 10W **£4.**

G.E.C. MANUAL OF POWER AMPLIFIERS
Covering valve amplifiers of 30W to 400W **35p.**

LOUDSPEAKERS FOR AMPLIFIERS
BAKER 25W, **£7·60;** 35W **£8·40;** Hi-Fi Major Module 20W w/tweeter crossover, **£11·80.** Baker Speaker Lists. FANE 60W **£13·50;** EMI 13 × 8in, 8Ω, **£2;** 5in 8Ω, **£1·15;** 7 × 4in 15Ω, **£1·60;** 8 × 5in 3, 8, 15 or 80Ω, **£1·75** each.

LOUDSPEAKERS
2½in 8 or 75Ω, 2½in 8 or 25Ω, 3in 3, 8, 25 or 35Ω, 3½in 8 or 80Ω, **95p** each; 5in 3, 8 or 25Ω, 5 × 3in 3 or 8Ω, **£1·15;** 7 × 4in 3 or 15Ω, 6½in 3Ω, **£1·30;** 10 × 6in 3Ω, **£1·50.**

SPEAKER AUTO MATCHING TRANSFORMER
12W 3 to 8 or 15Ω up or down, **£1·50.**

"INSTANT" BULK TAPE/CASSETTE ERASER
Instant erasure, any diameter tape spools, cassettes, demagnetises tape heads, 200/240V a.c., **£3·75.**

SYNCHRONOUS GEARED MOTORS, 200/240V a.c.
Brand new, Smiths. Built-in gearbox, 2r.p.h., **75p each.**
Carriage and VAT extra on all orders
S.A.E. ENQUIRIES, LISTS. MAIL ORDER ONLY

46 Kenilworth Road, Edgware, Middx. HA8 8YG
Tel. 01-958 9314

THE RADIO SHOP

16 Cherry Lane, Bristol, BS1 3NG
Tel. Bristol 421196. STD Code 0272

Your West Country shop for electronic components and solid state devices

THYRISTORS

PIV	1·6A	4A	6A	8A	10A	16A
	£	£	£	£	£	£
50	0·25	0·26	0·37	0·41	0·45	0·50
100	0·28	0·30	0·42	0·47	0·50	0·58
200	0·31	0·36	0·50	0·59	0·65	0·73
400	0·40	0·57	0·77	0·85	0·97	1·15

TRIACS

PIV	1·6A	3A	6A	8A	10A	16A
	£	£	£	£	£	£
100	0·26	0·28	0·44	0·50	0·60	0·82
200	0·28	0·34	0·56	0·64	0·74	0·88
400	0·38	0·50	0·80	0·92	1·04	1·32
600	0·52	0·66	1·00	1·14	1·28	1·75

TRIACS WITH INTERNAL TRIGGERS

PIV	1·6A	3A	6A	8A	10A	16A
	£	£	£	£	£	£
100	0·27	0·30	0·46	0·52	0·63	0·90
200	0·30	0·36	0·58	0·67	0·78	0·95
400	0·40	0·52	0·84	0·97	1·09	1·40
600	0·55	0·70	1·05	1·20	1·34	1·85

Quantity prices on application S.A.E.
Diacs for use with triacs **23p.**

CLOCK CHIP CT7001 £4·95
The unique CT7001 represents a major breakthrough in clock chip design; incorporating many features available for the first time . . . 365 day calendar—12/24 hour op.—alarm—snooze alarm—six digit capability—direct drive to L.E.D. display—continuous operation during mains failure.
Copy of data **15p;** Socket **75p.**

SPECIAL KIT comprising 1 × CT7001 × 4 L.E.D. 7 seg. displays, data sheets and socket, **£10.**
704 7 seg. L.E.D. display 3in. high, **£1·10** each.

LIQUID CRYSTAL 3½ digit display, **£7·49.**
NE555 Timer IC 8 pin DIL with data, **60p.**
741 Op. amp. I.C. 8 pin DIL with data, **40p.**

Please add 8% VAT to all listed prices—P. & P. 15p per order. Send 13p for latest catalogue.

Callers welcome

FREE!

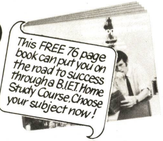
Over 150 ways to engineer a better future

HIGHER PAY

A BETTER JOB

SECURITY

find out how in just 2 minutes


This FREE 76 page book can put you on the road to success through a B.I.E.T. Home Study Course. Choose your subject now!

hat's how long it will take you to fill in the coupon. Mail it today and e'll send you full details and a free book. We have successfully trained *ousands* of men at home—equipped them for higher pay and better, ore interesting jobs. We can do as much for YOU. A low-cost home udy course gets results fast—makes learning easier and something look forward to. There are no books to buy and you can pay-as-you-arn.

/hy not do the thing that really interests you? Without losing a day's ay. *you* could quietly turn yourself into something of an expert. omplete the coupon (or write if you prefer not to cut the page). No bligation and nobody will call on you . . . but it could be the best thing ou ever did.

Others have done it, so can you

Yesterday I received a letter from the Institution informing that my applica-on for Associate Membership had been approved. I can honestly say that this as been the best value for money I have ever obtained. a view echoed by two olleagues who recently commenced the course.''—Student D.I.B.. Yorks.

Completing your course. meant going from a job I detested to a job that I love. ith unlimited prospects.''—Student J.A.O.. Dublin.

My training quickly changed my earning capacity and. in the next few years. y earnings increased fourfold.''—Student C.C.P.. Bucks.

FIND OUT FOR YOURSELF

hese letters. and there are many more on file at Aldermaston College. speak the rewards that come to the man who has given himself the specialised know-w employers seek. There's no surer way of getting ahead or of opening up w opportunities for yourself. It will cost you a stamp to find out how we can lp *you*. **Write to:**

ALDERMASTON COLLEGE

Dept. TPE05, Reading RG7 4PF

HOME OF BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

Practical Radio & Electronics Certificate course includes a learn while you build ***3 transistor radio kit.*** Everything you need to know about ***Radio & Electronics*** maintenance and repairs for a ***spare time income*** and a ***career*** for a better future.

CUT OUT THIS COUPON

Tick or state subject of interest.
Post to address below.

ELECTRICAL ENGINEERING
- City & Guilds Wiring and Installations ☐
- C. G. Electrical Tech.—Primary ☐
- Gen. Electrical Eng. ☐

AERONAUTICAL ENGINEERING
- Air Registration Board Certificates ☐
- Gen. Aero Engineering ☐

AUTO ENGINEERING
- City & Guilds Auto Engineering Practice ☐
- Inst. Motor Industry ☐
- M.A.A./I.M.I. Management Diploma ☐
- Gen. Auto Engineering ☐
- Auto Diesel Maintenance ☐
- Motor Mechanics ☐
- Service Station and Garage Management ☐

TELE-COMMUNICATIONS
- City & Guilds Telecommunications ☐

RADIO & TV
- Gen. Radio and TV Eng. ☐
- Radio Servicing, Maintenance and Repairs ☐
- Practical Radio & Electronics (with self-build kit) ☐
- Radio Amateurs' Exam. ☐

ELECTRONIC ENGINEERING
- Gen. Electronic Eng. ☐
- Practical Electronics (with kit) ☐

AGRICULTURAL ENG. REFRIGERATOR SERVICING

MECHANICAL ENGINEERING
- Society of Engineers ☐
- Inst. Engineers and Technicians ☐
- General Mechanical Eng. ☐
- Welding ☐
- Maintenance Eng. ☐
- General Diesel Eng. ☐

DRAUGHTSMANSHIP
- Institute of Engineering Draughtsmen & Designers ☐
- General Draughtsmanship ☐
- Architectural Draughtsmanship ☐
- Technical Drawing ☐

CONSTRUCTION & BUILDING
- Institute of Building ☐
- Construction Surveyor's Inst. ☐
- Clerk of Works Diploma ☐
- C. & G. Building Quantities ☐
- General Building ☐
- General Civil Eng. ☐
- Heating, Ventilating & Air Conditioning ☐
- Carpentry & Joinery ☐
- Painting & Decorating ☐
- Plumbing ☐
- C.E.I. (Part 1) ☐
- Inst. Cost & Management Accountants ☐
- Works Management ☐

G.C.E. —58 'O' & 'A' Level Subjects— over 10,000 Group Passes!

POST TODAY FOR A BETTER TOMORROW

To Aldermaston College, TPE05
Dept. TPE05, Reading RG7 4PF

NAME ……………………………………
Block Capitals Please
ADDRESS ……………………………………
……………………………………
…………………………………… POST CODE ……………
OTHER SUBJECTS ……………………………………
…………………………………… AGE ……………

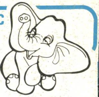
Accredited by C.A.C.C. *Member of A.B.C.C.*

ıblished approximately on the 15th of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London, EC4A 4AD. Printed in England by Chapel River Press, Andover, ants. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia) Ltd.: South Africa—Central News Agency Ltd.
ıblisher's Subscription Rate including postage for one year, Inland £3·85, Overseas £4·70, U.S.A. and Canada $13·00.
ternational Giro facilities Account No. 5122007. Please state reason for payment, "message to payee".

actical Electronics is sold subject to the following conditions, namely, that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise sposed of by way of Trade at more than the recommended selling price shown on the cover, excluding Eire where the selling price is subject to V.A.T., and that it shall not be lent, resold hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial atter whatsoever.

HENRY'S RADIO

LARGEST SELECTION OF ELECTRONIC COMPONENTS AND EQUIPMENT. LOW PRICES– MEAN LESS VAT.



You can build the Texan and Stereo FM Tuner

TEXAN 20 - 20 WATT IC STEREO AMPLIFIER

Features glass fibre PC board, Gardners low field transformer, 6–ICs, 10–transistors plus diodes, etc. Designed by Texas Instruments engineers for Henry's and P.W. 1972. Supplied with full chassis work, detailed construction handbook and all necessary parts. Full input and control facilities. Stabilised supply. Overall size 15½in × 2¾in × 6⅞in mains operated. Free teak sleeve with every kit.

£31·00 (Carriage 50p) (also built and tested **£37·50**)

STEREO FM TUNER Features capacity diode tuning, lead and tuning meter indicators, stabilised power supply—mains operated. High performance and sensitivity with unique station indication IC stereo decoder. Overall size in teak sleeve 8in × 2¾in × 6⅞in. Complete kit with teak sleeve **£21·00** (Carriage 50p)

(also built and tested **£24·95**)

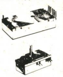
JOIN THE LARGE BAND OF HAPPY CONSTRUCTORS!

NEW SPECIAL PURCHASE

AM/FM TUNER MODULES

Mullard type LP1179 and LP1171.

These two modules together form a high quality AM/FM tuner covering the long, medium and VHF broadcast bands. Requires only 16 resistors and capacitors and a switch to complete. Supplied with circuits and spec. data.



LP1179	
FM Coverage	87–108MHz
Bandwidth	300KHz
Selectivity	35 dB
Signal to noise at limiting threshold	40 dB
Audio output with built-in tuning gang	75 mV
LP1171	
AM Bandwidth	6·5 KHz
Sensitivity	1 pV
Built-in AGC	

Supply 6V negative earth. LP1179 and LP1171 £4 each or **£7·50** pair. Suitable Ferrite aerial **75p.**

MULLARD MODULES

LP1157	AM/Type	2·50
LP1185	10·7 I.F. Unit	4·50
LP1186	10·7 F/M Tuner	4·85
Gorler Perm. F/M Tuner		4·20

Amplifiers with controls

E1210	12 volt 2½ + 2½ watts 8 ohms	8·25
SAC14	Mains 7 + 7 watts 8 ohms	11·75
SAC30	Mains 15 + 15 watts 8 ohms	14·95
CAO38	9 volt 1½ + 1½ watts 8 ohms	6·95
CAO68	12 volt 3 + 3 watts 8 ohms	10·50

POWER SUPPLIES MAINS INPUT

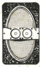
(*chassis-rest cased)

470C 6/7½/9V 300MA with ad'rs	2·25
P500 9V 500 MA	3·20
HC244R 3/6/7½/9V, 400 MA stabilised	5·50
*P11 24V ½A 3·30	3·30
*P15 28V, ½A	3·30
*P1080 12V 1A 4·70	7·80
*P1081 45V 0·9A	7·80
P12 4½–12V, 0·4–1A	7·15
SE101A 3/6/9/12V 1A stabilised	12·75
P1076 3/4½/6/7½/9/12V, ½A	4·20
SE800A 1–15 VOLT 0–½A stabilised	17·50

FM & AM TUNERS & DECODERS

FM5231 (TU2) 6 volt FM tuner	7·95
TU3 12 volt version (FM use with Decoder)	7·95
SD4912 Stereo Decoder for TU3 12 volt	7·95
SP62H 6 volt stereo FM tuner	11·95
A1007 9 volt MW–AM tuner	4·80
A1018 9 volt FM tuner in cabinet	13·95
A1005M (S) 9–12 volt Stereo decoder FM for above	7·50
1067 12V Stereo decoder gen. purpose	6·50
Gorler Permeability FM tuner (front end) 10·7 MHZ O/P	4·20

EMI SPEAKERS SPECIAL PURCHASE



13in × 8in chassis speakers (Carr/packing 30p each or 50p pr.)

*150TC 10 watts 8 ohms twin cone **£2·20**

150A Built-in tweeter 8 ohms **£3·85.**

EW 15 watt 8 ohm with tweeter **£5·25**

350 20 watt 8, 15 ohm with tweeter **£7·80** each.

* Polished wood cabinet **£4·80** carr., etc. 35p each or 50p pair.

UHF TV TUNERS

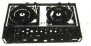
625 line receiver UHF transistorised tuners UK operation. Brand new. (Post/packing 25p each).

TYPE C variable tuning **£2·50**

TYPE B 4-button push-button (adjustable) **£3·50**

TYPE D 6-button UHF/VHF **£4·50**

PA DISCOTHEQUE LIGHTING EQUIPMENT



Without doubt U.K.'s best range of modular and complete equipment. Lighting, mixing, microphones, accessories, speakers, amplifiers, lenses, etc., etc.

FREE stock lists (Ref. No. 18) on request. CALL IN AND SEE FOR YOURSELF at **HENRY'S DISCO CENTRE, 309 EDGWARE ROAD, TEL. 01-723 6963**

SINCLAIR MODULES & KITS

SINCLAIR PROJECT 80

ST80 Stereo preamplifier	11·95
Audio Filter Unit	6·95
Z40 15 Watt Amplifier	5·45
Z60 25 Watt Amplifier	6·95
PZ5 Power Supplies for 1 or 2 Z40	4·98
PZ6 Power Supplies (S Tab) for 1 or 2 Z40	7·98
PZ8 Power Supplies (S Tab) for 1 or 2 Z60	7·98
TRANSFORMER FOR PZ8	4·00
FM TUNER	11·95
STEREO DECODER	7·95
IC20 power amp kit	7·95
PZ20 power supply for 1 or 2 IC20	5·45

PACKAGE DEALS (carr./packg. 35p)

2 × Z40 ST80 PZ5	25·00
2 × Z60 ST80 PZ6	27·75
2 × Z60 ST80 PZ8 trans	34·40
805 kit	35·95

Sinclair Special Purchases

*Project 60 stereo preamp **£6·75** (post **20p**)

*Project 605 Kit **£19·95** (post **25p**)

TEST EQUIPMENT MULTIMETERS

(Carr./packing 35p)

	£ p
U4324 20kΩ/V with case	9·85
U4313 20kΩ/V with steel case	13·80
U4317 20kΩ/V with case	17·00
U4341 33kΩ/V plus transistor steel case	11·00

	£ p
U4323 20kΩ/V plus 1kHz OSC with case	8·00
ITI-2 20kΩ/V slim type	5·95
THL33D (L33DX) 2kΩ/V Robust	7·50
TP5SN 20kΩ/V (Case £2)	10·75
TP10S 2kΩ/V	8·50
TW20S 20kΩ/V	13·00
TW50K 50kΩ/V	14·50
U4311 Laboratory meter	52·00
U4312 20kΩ/V with case	10·75
U4315 20kΩ/V with case	10·00
U4317 20kΩ/V with case	17·00
S100TR 100kΩ/V plus transistor tester	22·50

NEW REVOLUTIONARY SUPERTESTER 680R

680R Multi-tester	18·50
†TE40 AC Multivoltmeter	19·75
†TE15 Grid dip meter 440kHz-28mHz	19·50
†TE65 28 Range valve voltmeter	22·50
†TE20D RF Generator 120kHz-500mHz	18·95
†TE22D AF Generator 20Hz-200kHz	19·95
*HM350 in circuit transistor tester	19·50
*C3025 Deluxe meter 1–300mHz	6·95
*TT145 Compact transistor tester	14·75
†G3–36 R/C osc. 20Hz–200kHz	19·75
*SE350A Deluxe signal tracer	12·95
*SE400 Mini-lab. all in one tester	15·50
C1–5 Scope 500,000kHz (carr. £1)	43·00
Radio activity counter 0–10r (carr. £1)	9·97
Mains unit for above (carr. 50p)	3·75

TAPE HEADS

Marriot XRSP/17 ¼ Track High	2·50
Marriot XRSP/18 ¼ Track Med.	3·50
Marriot XRSP/36 ¼ Track Med.	5·00
Marriot XRSP/63 ½ Track High	1·75
Marriot Erase Heads for XRSP 17/18/36 (XES11)	75
Marriot BX1ZE 343 ½ Track Erase	75
R/RPI Record/Play ½ Track	45
H/RP Single Track Rec/Play	35
Bogen Type UL290 Erase	1·50
Miniature Stereo Cassette Rec/Play	2·25

(P.P. 15p)

EXCLUSIVE 5 WATT IC AMPLIFIERS

Special purchase 5 watt output 8–16 ohm load. 30 volt max. d.c. operation, complete with data. Price **£1·50** each or 2 for **£2·85.** Printed Circuit Panels **50p.**

CALCULATORS

8 DIGIT POCKET ELECTRONICS CALCULATORS

Sinclair Cambridge Built, **£11·00**

Sinclair Cambridge Kit, **£9·00**

Sinclair Cambridge Memory Built, **£17·50**

Sinclair Scientific Built, **£16·00**

Sinclair Scientific Kit, **£13·50**

VAT 8% EXTRA ON ALL ITEMS

FREE:
SEND NOW FOR OUR NEW *FREE* LIST NO. 36 FOR OUR COMPLETE RANGE OF OVER 10,000 SEMI-CONDUCTOR DEVICES AT *NEW LOW PRICES.*

TRANSISTORS & INTEGRATED I/C's

TTL "7400 series" I.C.'s from **16p** each.
Cosmos "4000 series" I.C.'s from **40p** each.
Linear op-amps from **40p** each.
Signotics phase lock I.C.'s.
RCA linear I.C.'s.
TO3 power devices in PNP and NPN.
BC107 and "BC range" from **12p.**
Range of "OC71" types **18p.**
Power regulator I.C.'s and many others.
Plastic power devices, rectifiers, zener diodes up to 10W.

DIL SOCKETS

8 pin	14p
14 pin	15p
16 pin	17p
24 pin	£1·15
28 pin	£1·25

NOMBREX TEST EQUIPMENT

MODEL 35 STABILISED POWER SUPPLY

A short circuit proof power supply delivery up to 30V at 1A. Built-in Volts and ammeters. **£34·00**

MODEL 40 WIDE RANGE AUDIO SIGNAL GENERATOR

A high stability signal generator using the low distortion Wien bridge principle. Covering 10Hz to 100kHz in 4 ranges. Adjustable output from 1mV to 1V. Sine and square wave output. **£34·0**

MODEL 41 RF SIGNAL GENERATOR

Covering 150kHz to 220MHz in 8 ranges. Built-in in AM mod. Output up to 50mV. Crystal calibration facilities. Large linear scale with slow motion drive **£38·0**

MODEL 42 WIDE RANGE RF SIGNAL GENERATOR

Covering 150kHz to 300MHz in 8 ranges. Highest range in harmonic. Built-in AF mod. Output up to 50mV. Circular scale. **£24·5**

MODEL 43 RC BRIDGE

Null indicating bridge for resistors and capacitors Resistance range 10R to 10M ±2% at centre scale Capacity range 10pF to 100µF ±2% centre scal except 1pF to 10µF range ±5%. Power facto measurement 0–70%. **£26·0**

MODEL 44 INDUCTANCE BRIDGE

Measures 1µH to 100H in 4 ranges ±5% accuracy Q measurement from 0·1–1,000±10%. **£34·0**

MODEL 45 DIRECT READING FREQUENCY METER

10Hz to 100kHz in 4 ranges. Input from 10MV to 5 **£36·0**

All models except Model 35 are internally powere from 9V battery (extra). Carriage and packing a models 37p.

NOW OPEN SUPERMARKET

Come and browse round the new component supermarket at 404 Edgware Road. Bargains galore Goodie bags. Components, etc.
WATCH FOR FURTHER DEVELOPMENTS

EXTRA DISCOUNTS

Semi-conductors. Any one type or mixed SN 74 Serie 'IC' 12+ EXTRA 10% 25+ EXTRA 15% 100+ EXTRA 20%

HENRY'S RADIO

Electronic Centres
404-406 Electronic Components & Equipment 01-402 8381
309 PA-Disco-Lighting High Power Sound 01-723 6963
303 Special offers and bargains store
All mail to 303 Edgware Road. London W2 1BW

Hi Fi and Electronics Centres Open 9 am - 6 pm

Prices correct at time of preparation. Subject to change without notice. E.&O.E